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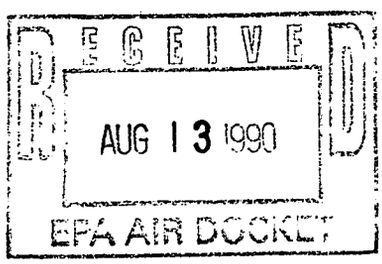

IN RE APPLICATION FOR A FUEL ADDITIVE WAIVER FILED BY ETHYL CORPORATION UNDER § 211(f)(4) OF THE CLEAN AIR ACT

REPLY COMMENTS OF ETHYL CORPORATION IN SUPPORT OF THE HITEC® 3000 WAIVER APPLICATION

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SUMMARY

Ethyl Corporation ("Ethyl") is seeking a waiver for use of the HiTEC® 3000 Performance Additive (the "Additive") in unleaded gasoline in the U.S. The Additive has been used widely in unleaded gasoline in Canada without adverse effects for over a decade, and for many years in leaded gasoline in the U.S.

In support of this waiver request, Ethyl has conducted the most extensive automobile fleet test program ever undertaken by a private company in connection with a waiver application. This test program, which took approximately two years to complete, involved the operation of 48 automobiles for over 3 million miles. The main focus of the program was to determine the effect, if any, of the Additive's use on the emissions of hydrocarbons ("HC"), carbon monoxide ("CO"), and oxides of nitrogen ("NOx").

I. TEST PROGRAM RESULTS

The results of this test program, described in detail in Ethyl's waiver submittal filed on May 9, 1990, show that use of the Additive would:

- Substantially reduce tailpipe emissions of NOx, CO, benzene and formaldehyde;
- Have no practical adverse effect on HC emissions;
- Permit a reduction in the aromatic content of unleaded gasoline;
- Cause no deterioration of automobile emission control systems;
- Pose no health or environmental problems; and
- Save more crude oil annually than is purchased each year for the strategic petroleum reserve.

Since Ethyl filed this waiver application, a variety of organizations and individuals have submitted comments. With few exceptions, the commentators, including General Motors Corporation, support approval of the waiver application. A limited number of commentators, however, have opposed the application, asserting either that use of the Additive could adversely affect public health or that more testing needs to be done to determine the impact of the Additive on automobile emission control systems before the waiver can be granted.

On July 23, 1990, Ethyl filed supplemental comments which exhaustively addressed the limited comments concerning public health. In these reply comments, Ethyl now responds to those commentators, principally certain automobile companies, who oppose the application primarily on the grounds that additional testing is needed.

II. AUTOMOBILE INDUSTRY COMMENTS

In apparent recognition of the "thorough" and "considerable information" supplied by Ethyl in support of its waiver application, General Motors recommended that EPA approve the waiver, subject to on-going testing and evaluation of the effects of the Additive in actual commercial use. In effect, General Motors -- the world's largest automobile producer -- does not challenge that Ethyl has satisfied the legal standard for approval of its waiver application.

The other automobile industry commentators expressed three basic concerns. First, they state that any increase in HC

emissions, no matter how small, is cause for concern, especially with respect to more stringent future emission standards. Second, they claim that the Additive can cause plugging or other adverse effects in catalysts. Finally, they assert the Additive could adversely affect public health because of increased environmental levels of manganese. Therefore, they request EPA to require Ethyl to conduct additional testing of the Additive prior to approval of the waiver.

No such testing, however, is required. Ethyl has undertaken numerous tests and analyses that specifically address each of the concerns raised. These tests and analyses show that:

- The Additive will not cause or contribute to the failure of emission control systems to meet current or future HC, CO or NOx emission standards.
- The Additive will not cause plugging or other adverse effects in catalysts, including close-coupled catalysts operated under severe conditions.
- The Additive will not adversely affect the public health, as established in Ethyl's July 23 submission.

The automobile industry commentators who request additional testing make no effort to address directly, and in some cases do not even acknowledge, the results of the extensive testing already completed by Ethyl.

III. THE AGENCY SHOULD APPROVE THIS APPLICATION.

The request for "more testing" should be recognized for what it reflects -- an inability to refute the merits of Ethyl's application and, unlike a meaningful discussion and analysis of Ethyl's data, does not demand rigorous analysis. Ethyl has already made detailed presentations in this proceeding on the

issues raised by these automobile commentators, demonstrating that their concerns are unwarranted. The Agency, therefore, should approve this waiver application.

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APPENDICES

I. INTRODUCTION

On May 9, 1990, Ethyl Corporation ("Ethyl") filed a waiver application under § 211(f)(4) of the Clean Air Act ("Act" or "CAA") for use of the HiTEC® 3000 Performance Additive (the "Additive") at a concentration of 0.03125 grams manganese per gallon of unleaded gasoline. On June 5, 1990, the U.S. Environmental Protection Agency ("EPA" or "Agency") published in the Federal Register a notice of a June 22, 1990 public hearing on the application, and solicited public comment.[1/]

A variety of organizations and individuals have responded to the Agency's request for comments. With few exceptions, these organizations, including General Motors Corporation, support approval of the waiver application.[2/] A limited number of commentators, primarily automobile manufacturers, however, have raised questions regarding the application, essentially arguing that more testing needs to be done to determine the impact of the Additive on emission control systems before the application can be granted.[3/]

[1/] 55 Fed. Reg. 22947 (1990). In comments filed on July 23, 1990, Ethyl responded to issues raised either at the public hearing or in comments available in the docket prior to its July 23 submission.

[2/] Almost 70 comments on the waiver application have been filed as of August 10. Particularly pertinent were the comments received from over 24 large and small refiners stressing the substantial environmental and economic benefits, as well as significant crude oil savings, resulting from the use of the Additive.

[3/] These automobile comments were filed within the last few days of the comment period providing insufficient time to be reviewed and commented upon in Ethyl's July 23 submission.

These reply comments explain how Ethyl's extensive test program -- a program designed in consultation with EPA and the automobile manufacturers -- addresses the issues raised by these automobile industry commentators, and why the factual record in this proceeding fully supports granting the waiver application.[4/]

II. ETHYL HAS SATISFIED THE LEGAL STANDARD FOR WAIVER APPLICATIONS UNDER § 211(f)(4) OF THE CLEAN AIR ACT.

A. The Statutory Standard

As Ethyl recognized in its waiver application, § 211(f)(4) places an affirmative burden on waiver applicants to demonstrate that fuel additives will not "cause or contribute" to the failure of emission control systems to meet applicable emission standards.[5/] EPA has defined what is required to meet this burden in guidance on the contents of waiver applications,[6/] and in prior waiver application decisions.[7/]

EPA's prior decisions and guidance make clear that, while § 211(f)(4) is intended to place an affirmative burden on applicants to show that an additive will not cause or contribute to the failure of emission standards, this provision is not

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[4/] No automobile company chose to state its concerns at the public hearing. At least two, Ford and Chrysler, elected instead to present their views in separate meetings with EPA staff concurrent with filing their written comments. See docket entries IV-E-2 and IV-E-3.

[5/] See, e.g., In Re Application for a Fuel Additive Waiver Filed by Ethyl Corporation Under § 211(f)(4) of the Clean Air Act (May 9, 1990) [hereinafter "Waiver Application"] at pp. 39-45.

[6/] 43 Fed. Reg. 11258 (1978).

[7/] See Waiver Application, at p. 42-45.

intended to create an impossible burden.[8/] Thus, an applicant need not test every possible type of vehicle, but only a representative selection of vehicles.[9/] In addition, an applicant need not show that there is no possibility of an emissions increase, however small, associated with use of an additive, but only that any increase will not cause or contribute to the failure of applicable emission standards.[10/] An applicant is not required to disprove negative propositions (e.g., to provide conclusive proof of the absence of an alleged effect in any vehicle), but rather to provide a reasonable factual basis through fleet testing and statistical analyses upon which to draw conclusions regarding the effects of the additive.[11/]

B. The Test Program

In recognition of these principles, Ethyl initiated discussions with EPA and the automobile industry in late 1987 to design a comprehensive test program addressing the effects of the Additive on automobiles and emission control systems.[12/] All

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8/ Id. at p. 43.

9/ Id.

10/ Id.

11/ Id.

12/ See Reply Comments of Ethyl Corporation in Support of the HiTEC® 3000 Waiver Application, Appendix 1 [hereinafter cited as "Appendix __"]. Appendix 1 contains, among other documents, two letters of July 19, 1988 and July 22, 1988 summarizing the discussions that took place over eight months between Ethyl and EPA regarding design of the test program, as well as three Ethyl memoranda of February 11, 1988, summarizing discussions with

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aspects of the fuel additive test program were addressed, including the types and numbers of vehicles to be tested, and the type of fuel to be used in the test vehicles.[13/]

These discussions resulted in the largest and most comprehensive test program ever undertaken by a private company in support of a fuel additive waiver application. The test fleet included the most popular engine types of the three domestic automobile manufacturers, as well as a variety of emission control systems. Two of the eight models selected had close-coupled catalysts, in order to reflect likely future emission control devices.[14/] The test program also required frequent emissions testing using EPA procedures. Emissions testing was ultimately extended beyond the required 50,000 miles to 75,000 miles, in order to provide information to evaluate vehicle performance under possible future emission standards and warranty provisions.[15/]

12/ (...continued)
General Motors, Ford and Chrysler on the composition of the test fleet and the expressed concerns of the automobile companies.

13/ See Appendix 1. The discussions on the test protocol addressed, for example, whether light duty trucks should be included in the test fleet, and whether commercial fuel should be used in the test cars. See infra p. 33 and p. 41.

14/ See Waiver Application, Appendix 1, at p. 2.

15/ See Waiver Application, at p. 5. Ethyl also consulted with the automobile manufacturers on whether to extend testing beyond 75,000 miles to 100,000 miles. The automobile manufacturers indicated that this would not be important. See Appendix 1 (Memorandum from Gary Ter Haar dated April 27, 1990).

This comprehensive test program ultimately generated over three million miles of operating experience and over 2500 emission tests for evaluating the effects of the Additive on automobiles and emission control devices. These data were subjected to detailed analyses by two independent statistical consultants.[16/] Both concluded that the Additive would not cause or contribute to the failure of emission control systems to meet applicable emission standards, including the emission standard for hydrocarbons (HC).[17/]

C. The Automobile Industry Comments

In apparent recognition of the "thorough" and "considerable information" that Ethyl provided in support of its waiver application, General Motors, the largest producer of automobiles in the world, has recommended that the Agency approve Ethyl's waiver application, subject to on-going testing and evaluation of the effects of the Additive in commercial use.[18/] Having

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16/ See Waiver Application, Appendices 2A and 2B, which contain the statistical analyses performed by Systems Applications, Inc. (SAI) and Roberson Pitts, Inc. (RPI).

17/ See id., Appendix 2A at p. 71; Appendix 2B, at p. 6. Beyond this comprehensive test program, Ethyl also undertook a number of additional programs to evaluate further the effect of the Additive on automobile and emission control systems. These programs, which are discussed in Appendices 3 through 11 to the Waiver Application, confirm the results of the test program described above -- that use of the Additive will not cause or contribute to the failure of emission control devices or systems to meet applicable emission standards.

18/ See Comments of General Motors Corporation on the Ethyl Corporation Fuel Additive Waiver Request to Add Methylcyclopentadienyl Manganese Tricarbonyl (MMT) to Unleaded

(continued...)

carefully reviewed the test data and with some reservations, General Motors has not challenged that Ethyl has met the burden established by § 211(f)(4) of the Act.

Unlike General Motors, the Ford Motor Company neither recommends approval nor denial of the waiver application. Instead, Ford recommends that "EPA require additional testing and analysis of the effects of MMT on vehicle emission control systems before making their decision on the waiver application."[19/] In a similar vein, the Manufacturers of Emission Control Association ("MECA") states its view that "greater testing and evaluation is necessary" before EPA can grant Ethyl's waiver application.[20/]

Only a handful of commentators -- principally foreign automobile manufacturers and the Chrysler Corporation -- recommend that the application be denied. These comments also

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18/ (...continued)
Gasoline (July 23, 1990) [hereinafter "General Motors Comments"], at p. 1.

19/ Ford Motor Company's Comments in Response to Ethyl Corporation's Application for Waiver to Allow Methcyclopentadienyl Manganese Tricarbonyl (MMT) at 1/32 Gram/MMT U.S. Gallon Unleaded Gasoline (July 23, 1990) [hereinafter "Ford Comments"], at p. 6. Indeed, Ford has indicated its willingness to work with Ethyl to conduct the additional testing they seek. In a letter from the Chairman of the Board of Ford Motor Company to Ethyl dated July 12, Ford's Chairman wrote, "I agree with you wholeheartedly that, given the significant environmental challenges all of industry will face under the new Clean Air Act, cooperation among industries which have mutual customers is of great benefit."

20/ Letter to William Reilly from Bruce Bertelsen, Executive Director, Manufacturers of Emission Controls Association dated July 19, 1990 [hereinafter "MECA Comments"], at p. 4.

express the view that Ethyl's test program should have been even more extensive. Chrysler, for example, asserts that "[w]hile Ethyl believes it has thoroughly evaluated the effects of MMT, Chrysler [still] has some major concerns."[21/] Toyota suggests that "[f]urther study should be conducted before the use of MMT is approved."[22/] The Association of International Automobile Manufacturers ("AIAM"), whose members include Volkswagen and Nissan, urges EPA "to refrain from acting on the Ethyl Corporation application until it can be stated with some degree of certainty that MMT does not contribute to the failure of emission control related devices."[23/]

21/ Letter to Air Docket with attachments from G.E. Allardyce, Executive Engineer, Chrysler Motors Corporation dated July 23, 1990 [hereinafter "Chrysler Comments, Technical" or "Chrysler Comments, Legal Memorandum"], at p. 1.

22/ Letter to Air Docket from Kenji Ito, Executive Vice President, Toyota Technical Center, U.S.A., Inc. dated July 23, 1990 [hereinafter "Toyota Comments"], at p. 1.

23/ Letter to Air Docket from Gregory J. Dana, Vice President and Technical Director, Association of International Automobile Manufacturers, Inc. dated July 21, 1990 [hereinafter "AIAM Comments"], at p. 2. In its comments, Volkswagen indicates that it "concurs with the comments presented by [AIAM] on behalf of its members." Letter to Air Docket from Wolfgang Groth, Manager, Volkswagen of America, Inc. dated July 23, 1990 [hereinafter "Volkswagen Comments"], at p. 1. Nissan is the only company which appears to oppose use of the Additive irrespective of additional testing. The Agency should accord little weight to Nissan's opposition, however, because Nissan indicates that it "does not have any emission durability data using the MMT concentration level proposed to be used in HiTEC 3000." Nor does Nissan make any attempt to discuss Ethyl's test data. Letter to Document Control Officer from Satoshi Nishibori, Vice President, Nissan Research & Development, Inc. dated July 22, 1990 [hereinafter "Nissan Comments"], at p. 1.

D. Additional Testing of the Additive Is Not Necessary.

As noted above, the common thread of all of the automobile industry comments is a call for "more testing." Of course, given the size and variety of the national automobile fleet more testing can always be done no matter how thorough a test program is conducted. Indeed, this is precisely why Ethyl took such great care to design a comprehensive test program in consultation with EPA and the automobile industry.

Ethyl has already made a detailed presentation in these proceedings on the issues raised by these commentators.[24/] As discussed in ensuing sections, the commentators who call for more testing fail to address the results of the testing already conducted by Ethyl on these same questions. The only explanation for this failure is that these commentators have not reviewed Ethyl's entire waiver application. Ethyl believes that the Agency should be cautious in according any weight to comments made without review of the entire record.

In sum, Ethyl has met the burden imposed on waiver applicants by § 211(f)(4) of the Act. While additional testing is always possible, additional testing clearly is not a burden that Ethyl has to meet in this proceeding.[25/] In order to

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[24/] See Waiver Application, Appendices 1, 2, 3, 6, 8, 10 and 11; Comments in Support of the Waiver Application for the HiTEC® 3000 Performance Additive filed by Ethyl Corporation on July 23, 1990, (hereinafter "Ethyl Comments"), Appendices 9, 10 and 11.

[25/] Indeed, any additional testing that might be done would either be cumulative (e.g., adding another vehicle type to those

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complete the record in this proceeding, however, these reply comments respond to each of the questions raised by those automobile industry commentators.

III. COMMENTS SUBMITTED BY THE AUTOMOBILE INDUSTRY DO NOT REFUTE THE SHOWING BY ETHYL THAT USE OF THE ADDITIVE WILL NOT CAUSE OR CONTRIBUTE TO THE FAILURE OF EMISSION CONTROL SYSTEMS TO MEET APPLICABLE EMISSION STANDARDS.

As noted above, not a single commentator has made any attempt to challenge directly the extensive independent statistical analyses supporting Ethyl's waiver application. Unable to rebut the core of Ethyl's case, the automobile industry commentators who oppose the application simply embrace the argument that the extensive testing completed by Ethyl is not enough, and that more testing should be required before the application can be approved. As discussed below, this call for "more testing" is not persuasive.

The following discussion initially reviews several issues common to the comments of the automobile industry commentators. The comments of those automobile industry commentators who commented in more than a perfunctory manner are then addressed issue-by-issue.

25/ (...continued)
already evaluated), or cannot currently be addressed in greater depth than already addressed by Ethyl (e.g., whether the use of the Additive in future cars would affect compliance with future standards). As General Motors apparently recognizes, § 211(f)(4) of the Act does not contemplate that such testing be done before a waiver is granted. General Motors Comments, at p. 1.

A. Issues Raised Generally by the Automobile Industry

A review of the automobile industry comments reveals that the automobile industry commentators share three basic concerns. First, there is a concern that even the very slight increase in HC emissions observed in the test program could cause or contribute to exceedances of the HC emission standard.[26/] Second, questions have been raised regarding whether use of the Additive could cause catalyst plugging.[27/] Finally, several of the commentators assert unsubstantiated concern with the public health effects of manganese.[28/] Each of these issues is addressed in turn.

1. HC emissions

With respect to HC emissions, several of the automobile industry commentators suggest that any increase in HC emissions, no matter how small, is grounds for disapproving this application.[29/] As Ethyl has indicated, this is not an accurate

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[26/] See Ford Comments, at p. 3; Chrysler Comments, Technical, at pp. 4-6; General Motor Comments, at p. 1; Volkswagen Comments, at pp. 2-3; Toyota Comments, at p. 2; AIAM Comments, at p. 1.

[27/] See Ford Comments, at p. 4; Chrysler Comments, Technical, at pp. 2-4; General Motor Comments, at p. 2; Volkswagen Comments, at p. 1; Toyota Comments, p. 2; AIAM Comments, at p. 2; MECA Comments, at p. 2; Nissan Comments, at p. 2.

[28/] See Ford Comments, at p. 5; Chrysler Comments, Technical, at pp. 6-7; Toyota Comments, at p. 2; Volkswagen Comments, at p. 2; AIAM Comments, at p. 2.

[29/] See, e.g., AIAM Comments, at p. 1 ("an increase of hydrocarbon emission levels of any magnitude is of major concern"). The only statistically significant change in HC emissions for vehicles using the Additive in Ethyl's test program

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interpretation of the law.[30/] Moreover, not one of these commentators disputes Ethyl's statistical analysis showing that use of the Additive (1) reduces overall pollutant emissions; and (2) will not "cause or contribute" to the failure of emission control systems to meet applicable emission standards, including the HC standard.[31/] More specifically, these commentators do not

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29/ (...continued)
occurred within the first 5000 miles of vehicle operation (on average, approximately 0.02 gpm) and remained constant thereafter.

With respect to this slight increase in HC emissions observed in the test program, Ford questions why the adverse effects of HC emissions that were demonstrated in studies conducted in the late 1970's with 1/8 and 1/16 gm Mn/gallon are not "so readily apparent" in Ethyl's more recent 1/32 gm Mn/gallon test program. The answer to this query is easily explained: (1) the concentration of the Additive at issue in this waiver request (1/32 gm Mn/gallon) is substantially lower than that analyzed in many of the studies conducted in the late 1970's; and (2) automobile technology has improved dramatically since the late 1970's. See Appendix 2, at pp. 8-10.

30/ EPA has recognized that the cause or contribute standard established by § 211(f)(4) does not require an applicant to demonstrate that the fuel additive will not cause any increase in exhaust emissions. Motor Vehicles Mfrs. Ass'n of U.S. v. E.P.A., 768 F.2d 385, 390 (D.C. Cir. 1985). Rather, the applicant need only demonstrate that the fuel additive does not cause or contribute to a failure to meet emission standards. See Motor Vehicles Mfrs. Ass'n, 768 F.2d at 390 ("the Administrator is not required under section 211(f)(4) to adopt a 'no increase' standard"). See also Waiver Application, at pp. 54-56.

31/ While some of the automobile industry commentators -- most notably Chrysler -- assert that the slight increase in HC emissions observed in Ethyl's test program shows that the Additive "causes or contributes" to the failure of emission control systems to meet the HC emission standard, this interpretation of the law, as noted above, is in error. See supra note 30. There is no reference at all in any of the comments submitted by the auto industry commentators, including Chrysler, to the extensive statistical analyses shown in
(continued...)

dispute that the Additive meets the criteria EPA has used in the past to judge whether a waiver applicant has met the burden established under CAA § 211(f)(4).[32/] Nor do they challenge Ethyl's showing that use of the Additive would reduce the overall reactivity of HC emissions.[33/]

Ethyl also showed, however, that even the very slight HC emission increase observed in the test program is unlikely to occur in commercial operation as refineries substitute the Additive for aromatics. Only one auto company, Chrysler, challenges this claim. Chrysler asserts that refineries may

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31/ (...continued)
Appendices 2A and 2B of Ethyl's waiver application.

Moreover, AIAM states that "[i]n Canada . . . automobile manufacturers continue to gather additional evidence demonstrating that . . . MMT is indeed a major contributing factor to failing emission control devices." AIAM Comments, at p. 2. Not one piece of evidence supporting this allegation is presented by AIAM or any of the other automobile commentators. Indeed, the record in this proceeding shows just the opposite. Both Petro-Canada, Inc. (enroute to the docket) and Imperial Oil (enroute to the docket) report no complaints related to use of the Additive in over a decade of use. Finally, all of the studies conducted by the Canadian government or independent organizations to date have found no problems associated with use of the Additive. Ethyl Comments, at pp. 49-52. AIAM's broad and unsupported allegations are not entitled to any weight.

32/ Chrysler, for example, acknowledges that EPA used nine tests in 1978 to determine whether the Additive met the § 211(f)(4) legal standard for emission control systems. See Chrysler Comments, Legal Memorandum, at p. 3. Conspicuous in its absence is any discussion by Chrysler of the fact that use of the Additive in Ethyl's 48-car test program passes this same series of tests. Id.

33/ "Reactivity" is a measure of the ozone-forming potential of specific hydrocarbon emissions. See Ethyl Comments, at pp. 16-17.

decide to use the Additive to back out "high octane paraffins . . . that pollute less rather than the lower-cost, high octane aromatics" that result in significant HC emissions.[34/] This unsubstantiated assertion is repeatedly contradicted by the comments of the refiners themselves, who have indicated that aromatics will, in fact, be reduced with use of the Additive in commercial operation. For example, the National Petroleum Refiners Association, whose members include virtually every refiner and petrochemical manufacturer in the United States, has commented that use of the Additive would "save energy required for high severity processing that would otherwise be required to achieve higher octane levels, at the same time reducing the quantity of less desirable by-products."[35/] This conclusion has been echoed in comments submitted to the docket by large and

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[34/] Chrysler Comments, Technical, at p. 5. Chrysler suggests that paraffins are a higher cost component of gasoline. Id. This is, at best, a simplistic view. While operating costs for alkylation units (which produce paraffins) are higher than for reforming units (which produce aromatics), alkylation units are an important means of increasing gasoline volume and octane. Second, feedstocks to alkylation units are propylene, butylenes and isobutane. Because of the volatility of these feedstocks, little, if any, of these materials can be blended directly into gasoline under current EPA regulations. With the excess of butane that already exists during the summer months, refiners are not likely to create additional surpluses by reducing feedstocks to their alkylation units. Refiners will use these feedstocks to produce paraffins for use in gasoline since the only real alternative would be to dispose of these feedstocks by either using them as refinery fuel or flaming them to the environment. See Waiver Application, Appendix 6, Attachment 6-1.

[35/] Letter to EPA from Urvan Sternfels, President, National Petroleum Refiners Association dated July 23, 1990 (docket entry IV-D-52) (emphasis added).

small refiners alike.[36/] Chrysler's assertion is also contradicted by the analysis conducted by Turner, Mason & Company, the well-known oil industry analysts.[37/] The reduction in aromatics which will occur in commercial operation with use of

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[36/] See, e.g., Letter to EPA from G.A. Hickman, Vice President, Longview Refining Associates, Inc. dated July 20, 1990 (docket entry IV-D-60)(Use of the Additive "would permit us to lower our reformer severity thereby lowering the level of aromatics in our gasoline."); Letter to EPA from Jeff Hart, President, MAPCO Petroleum, Inc. dated July 12, 1990 (docket entry IV-D-26)(Use of the Additive would "[r]educe [the] level of aromatics in gasoline."); Letter to EPA from Dennis McCormick, Executive Vice President, Wyoming Refining Company dated July 18, 1990 (docket entry IV-D-61)(Use of the Additive "would allow us to lower our reformer severity thus lowering the level of aromatics in our gasoline."); Letter to Air Docket from Jerry Jenkins, Vice President, Fina Oil and Chemical Company dated July 20, 1990 (docket entry IV-D-62)("HiTEC 3000 will reduce aromatic content of gasoline."); Letter to EPA from J.P. Chamberlain, Vice President and CEO, American International Refinery, Inc. dated July 20, 1990 (docket entry IV-D-63)(Use of the additive would lower "the level of aromatics in our gasoline."). See also Ethyl Comments, at p. 16, note 33 (similar comments submitted by Clark Oil and Refining Corporation, Fletcher Oil and Refining Company, ARCO Products Company, Howell Hydrocarbons, Inc., and The Louisiana Land and Exploration Company).

[37/] Waiver Application, Appendix 6 (use of the Additive would reduce reformer severity, and thereby reduce the aromatic content in gasoline from 31.2 percent of gasoline volume to 30 percent). Chrysler further asserts that the reduction in HC emissions that would occur from backing out aromatics -- a conclusion not contradicted by any commentator -- is not relevant under § 211(f)(4) because it would "pass[] the burden of MMT's increased hydrocarbon emissions to the refineries." Chrysler Comments, Technical, at p. 5. This assertion by Chrysler is also unfounded. The statistical analysis completed by SAI and RPI shows that use of the Additive will not cause or contribute to the failure of the HC emission standard regardless of the Additive's impact on the aromatic content of gasoline. Waiver Application, Appendices 2A and 2B.

the Additive is clearly relevant to a decision on this waiver application.[38/]

Finally, several automobile industry commentators question whether the slight HC emission increase observed in Ethyl's test program will impede efforts to comply with more stringent future emission standards. This issue was thoroughly addressed by Ethyl in Appendix 11 of the Waiver Application. In that document, Ethyl shows that use of the Additive will not cause or contribute to the failure of emission control systems to meet future emission standards.[39/] None of these commentators has addressed or refuted this analysis, an analysis based on actual test data rather than pure speculation.[40/]

[38/] It is astounding that Chrysler would suggest that reductions in aromatics -- a measure that will lead to lower HC emissions and other significant public health benefits -- is not relevant to this application, while suggesting that the public health effects associated with manganese are. See Chrysler Comments, Legal Memorandum, at pp. 5-6.

[39/] See Waiver Application, Appendix 11.

[40/] Chrysler, for example, suggests that Ethyl is obligated to "consider impending standard revisions." Chrysler Comment, Legal Memorandum, at p. 7. This is precisely what Appendix 11 of the Waiver Application does, and yet, Chrysler makes no reference to this analysis. Unable to refute the analysis in Appendix 11, several commentators generally point to potentially more stringent HC standards proposed in California, and suggest that use of the Additive could make it more difficult to meet these standards. See, e.g., Chrysler Comments, Legal Memorandum, at p. 7; Toyota Comments, at p. 1; AIAM Comments, at p. 1. This argument proves nothing. Not only are these standards only proposals, they would apply only in California, where the Additive presently cannot be used even if EPA grants this waiver application. Moreover, as Ethyl's supplemental comments have shown, the reduction in reactivity of HC emissions associated with use of the Additive could actually help to attain more

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In sum, the concerns presented by automobile industry commentators regarding the slight HC emissions increase observed in Ethyl's test program are unfounded. These commentators studiously ignore the extensive test program and analyses conducted by Ethyl which affirmatively establish that the Additive will not cause or contribute to the failure of emission control devices to meet present or future HC emission standards.

2. Plugging in catalysts

The automobile companies also express concern that use of the Additive will cause plugging in catalytic converters.[41/] This concern has no basis in fact. None of the limited amount of data submitted by these commentators in support of this general concern regarding plugging withstands critical analysis.[42/] In no case, moreover, do any of these commentators directly challenge the conversion efficiency and back pressure data from Ethyl's test program showing that use of the Additive does not cause plugging in catalysts.

More specifically, the automobile companies focus on potential plugging in close-coupled catalysts. Chrysler, for example, argues that "Ethyl's research did not address conditions that are prone to catalyst plugging (i.e., close-coupled catalyst

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40/ (...continued)
stringent HC standards in California. See Ethyl Comments, Appendix 1, Attachment 4.

41/ See supra note 27.

42/ Ethyl addresses each of the plugging concerns in detail, see infra pp. 24-30 and 46-48.

subjected to heavy load, high speed conditions)."[43/] However, two of the eight vehicle models used in the test fleet (Models E and F) were equipped with close-coupled catalysts.[44/] The impact of the Additive on catalytic performance in these vehicles (as measured by catalytic conversion efficiency and back pressure tests) was no different than the impact of the Additive on vehicles equipped with different catalytic systems, even under high speed, high temperature driving conditions.[45/] Indeed, the catalytic conversion efficiency of the close-coupled catalysts in Model E cars using fuel containing the Additive was better than that for the Model E cars using clear fuel for all of the regulated pollutants.[46/]

Both Ford and Chrysler have also submitted photographs of Canadian catalysts in an attempt to support their concern that

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[43/] Chrysler Comments, Technical, at p. 4.

[44/] General Motors therefore was unaware of this when it states that "only one of the eight vehicle types tested had a close-coupled monolithic converter." General Motors Comments, at p. 2.

[45/] See Waiver Application, Appendix 3. A back pressure test is an effective method of detecting catalyst plugging because it is a measure of the restriction generated by the catalyst and the acoustic components of the exhaust system. Id. at p. 5. Similarly, calculating the conversion efficiency of a catalyst provides a direct measure of the "in-use" effectiveness of the catalyst. Id. at pp. 3-5. The conversion efficiencies for the closely-coupled catalysts from the vehicles used in the high speed, high temperatuare test program are shown in Appendix 2.

[46/] Waiver Application, Appendix 3, Attachment 3-12. Indeed, the catalysts in the model F cars are so closely-coupled to the exhaust manifold that Ethyl was unable to insert a probe for engine-out emission analysis. Id.

the Additive could cause plugging in catalytic converters.[47] Photographs, however, as opposed to actual tests on the catalysts, have little, if any, value as a measure of catalyst performance. For example, photographs of the inlet face of catalysts removed from vehicles in Baton Rouge, Louisiana, where the Additive is not used in unleaded gasoline, show many of the same characteristics as the catalysts removed by Ford and Chrysler in Canada.[48] This means that photographs, standing alone, provide little, if any, useful information.[49]

The best way to test objectively the operating efficiency of a catalyst is by means of back pressure tests and conversion efficiency calculations. These are the tests that Ethyl relied upon in its test program.

Moreover, the automobile company comments are particularly noteworthy for what they do not provide on the issue of plugging. If use of the Additive plugs catalysts, as the auto companies claim, they could have provided detailed information regarding

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[47] Ford Comments, Attachments 1 and 2; Chrysler Comments, Technical.

[48] See Appendix 2, Attachment 5.

[49] A case in point is illustrated by the photographs of a catalyst in Appendix 3 from a Ford Taurus operated in Canada by Petro-Canada, Inc. for over 100,000 miles. These photographs show a manganese oxide coating on the catalyst which had no effect on the catalytic converter's ability to meet applicable Canadian emission standards. All of the emission test data obtained from the vehicle after 100,000 miles of operation were well below applicable Canadian emission standards notwithstanding the presence of manganese oxide on the catalyst. See Appendix 2, at p. 7, and Attachment 2.

differences in catalyst-related warranty claims in the United States, where the Additive is not used in unleaded gasoline, and Canada, where the Additive has been used in unleaded gasoline for over a decade. They did not. They also could have provided test data generated under actual test conditions (as opposed to laboratory conditions) showing that use of the Additive increases exhaust back pressure and reduces catalytic conversion efficiency. They did not.[50/]

Lacking real world emission data to support their assertions, the auto companies are left to speculate on potential problems, based largely on bits of old data generated in studies addressing older cars and higher concentrations of the Additive.[51/] Given the auto companies' unwillingness to address directly the results of Ethyl's substantial test program, those comments should be given no weight.

3. Manganese and the public health

Several of the automobile companies assert that emissions of manganese associated with use of the Additive could adversely affect public health.[52/] None of these commentators, however,

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[50/] As a general matter, little in the way of material supporting the auto industry assertions was supplied by these commentators. The largest submittal was made by Ford, but even it pales in comparison to the extensive amount of material filed by Ethyl in this proceeding. Most of the other comments comprised no more than few pages of text. See, e.g., Toyota Comments; Nissan Comments; MECA Comments.

[51/] These studies are discussed at length at pages 24-30 and 46-48, infra, and in Appendix 2.

[52/] See supra note 28.

provide any scientific basis for the alleged public health concern, or attempt to address the numerous studies conducted by governmental organizations around the world on the health effects of manganese. This leads one to question the credibility of these "alarmist" and unsupported assertions.[53/]

On the public health issue, Ethyl has shown that use of the Additive will reduce emissions of NOx, CO, aromatics such as benzene, and formaldehyde.[54/] This is not credibly disputed by these auto companies, or indeed, by anyone else.[55/] These are the mobile source pollutants with which Congress has expressed the most concern.[56/] If the auto companies are truly concerned about

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[53/] In particular, the motivation of Volkswagen for expressing concern about the potential health effects of manganese is suspect. Although, as Volkswagen indicates, it did not market the emission control system using a manganese-based fuel additive that it developed for diesel-powered vehicles, it sought and received conditional EPA approval for use of the system. Whatever the reason Volkswagen chose not to market the system, Volkswagen is clearly asking EPA to be more protective of public health here than it was when approving Volkswagen's system. Moreover, automotive materials typically contain a large amount of manganese in their own right, averaging 7 to 8 pounds of manganese in the form of steel alloy. See Letter to Public Docket from Dr. Francis Keenan, Director, Chemetals dated July 18, 1990 (docket entry IV-D-30), at p. 9. Given this amount of manganese in cars, one can reasonably question the depth of the automobile companies concern about manganese.

[54/] See Waiver Application, at pp. 60-67. Of note, one environmental group has recently issued a well-publicized study highlighting the "health-threatening" emissions of benzene and other aromatics from automobiles. See USA Today (July 24, 1990) at 4A; The Washington Times (July 24, 1990) at C12.

[55/] Ford asserts, without support, that the reduction in emissions of NOx observed in Ethyl's test program is unexplained. This view is in error. See infra at pp. 36-40.

[56/] See, e.g., Waiver Application, at p. 50, n. 117.

public health issues, one wonders why they have not welcomed the overall reduction in emissions shown to result from use of the Additive.

With respect to manganese, Ethyl has reaffirmed in its July 23 supplemental comments that use of the Additive does not pose any public health concern. It merits notice, moreover, that the automobile company comments concerning public health issues are presented in no more than a few sentences. By contrast, Ethyl has submitted hundreds of pages of material which shows that low level manganese concentrations in the environment do not present a public health concern.[57/] The unsupported assertions of the auto companies do nothing to challenge Ethyl's extensive

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57/ See Ethyl Comments, Appendices 1-8.

health submittals.[58/] As a result, consideration of public health

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[58/] Indeed, the only new health issue of substance raised by any of the commentators derives from a book prepared by the Health Effects Institute and cited by Chrysler on "Air Pollution, the Automobile, and Public Health" (A.Y. Watson, R.R. Bates & D. Kennedy, eds. 1988). This book, the goal of which is "to identify issues and select a research agenda that will be most effective in advancing our ability to quantify the health risks associated with air pollution," (Id. at 18) touches only briefly on manganese. Although one can always recommend additional research to address uncertainties in scientific data bases, such as that on manganese and health, only three of the 224 research recommendations in this book (and six of the almost 700 pages) concern manganese. In keeping with the lack of evidence in the existing data base that manganese levels associated with automotive emissions pose a threat to public health, none of the three recommendations addressing manganese is denominated as "high priority."

Moreover, simultaneously with the preparation of this book, HEI was engaged in a far more detailed examination of the potential impact of airborne manganese concentrations as high as 0.5 ug/m^3 on public health. See Potential Health Effects of Manganese in Emissions from Trap-Equipped Diesel Vehicles, A Report from the Health Effects Institute (September 1988). Evaluating comprehensively the evidence on neurotoxicity that underlies the recommendations for further research on manganese, this report concluded that there was no significant risk of neurological effects at 0.5 ug/m^3. See Ethyl Comments, Appendix 3, at Attachment B-2, p. 2. The manganese concentration following approval of HiTEC® 3000 would be significantly lower. Id. at Appendix 2. In addition, Ethyl has submitted letters and reports by several health experts familiar with data on the neurotoxicology of manganese that indicate public health would not be endangered by the addition of HiTEC® 3000 to gasoline as proposed by Ethyl. Id. at Appendix 7.

Finally, Chrysler asserts in passing, based on an analysis completed in the late 1970's, that use of the Additive could increase sulfate formation from the oxidation of SO_2. Chrysler Comments, Technical, at p. 7. More recent studies, however, indicate that this is not a valid concern. See Martin and Hill, Atmos. Environment, 21, p. 2267 (1987); Gery et al, "Development of a Comprehensive Chemistry Acid Deposition Model," prepared for Atmospheric Research Laboratory, U.S. EPA (1987).

strongly supports granting this waiver application.[59/]

B. The Concerns Expressed by Specific Automobile Companies Do Not Withstand Critical Analysis.

1. Ford

The comments submitted by Ford argue that Ethyl must conduct additional testing to establish "conclusively" the effects of the Additive on catalysts, EGO sensors, and fuel injectors before its waiver application can be granted.[60/] Ford, however, makes no attempt to refute directly the extensive statistical analyses and other work already presented that address these issues -- testing which demonstrates that Ford's concerns are unwarranted.

[59/] While the Environmental Defense Fund (EDF) has filed additional comments on public health, these comments do little more than repeat EDF's statement at the public hearing. See Letter to the Air Docket from Karen Florini, Environmental Defense Fund dated July 20, 1990. Ethyl responded to that statement in detail in its supplemental comments of July 23. Moreover, it should be noted that in its latest comments, EDF concedes that the public health issue is made relevant to this proceeding by the purposes clause of the Act (see EDF Comments, at pp. 1-2) -- a provision that informs any general exercise of discretion on the part of the Agency. EDF focuses, however, on only one part of the purpose clause (i.e., public health) and on only one issue relevant to that part of the clause (i.e., the public health effects of manganese). As EPA has stated, the purposes clause calls for a balancing of the overall social and economic consequences of a decision under the Act. Ethyl Comments, at p. 8, note 13 and accompanying text. In exercising its discretion, therefore, EPA must take into account all of the factors bearing on the "public health and welfare" and the "productive capacity" of the nation, including the significant pollutant reductions and the economic and energy benefits associated with use of the Additive.

[60/] Ford Comments, at p. 1.

The following discussion addresses in detail Ford's comments on specific issues, and shows that these issues have already been thoroughly addressed in this proceeding.

a. Ford catalyst studies

In support of its assertion that use of the Additive will cause plugging in catalysts, Ford relies on several studies that are either seriously flawed or fail to support its allegations.[61/]

The most recent set of studies Ford relies upon were conducted on Canadian catalysts exposed to fuel containing up to twice the level of the Additive requested in this proceeding. The analyses were based on laboratory testing using simulated exhaust gas streams. As a result, while these studies purport to show a decline in the conversion efficiency of catalysts, this effect is shown only under simulated laboratory conditions at substantially higher concentrations of the Additive. Significantly, this effect is not shown in testing of the Additive under real world conditions at the concentrations proposed in this application.[62/]

61/ Ford Comments, at pp. 1-2, and related attachments.

62/ See Appendix 3. This appendix provides SAI's analysis of the data presented by Ford in Attachment 5 of their comments (which SAI was unable to fully reproduce using data set Ethyl4S2), and provides a detailed statistical analysis of the conversion efficiency data from Ethyl's test fleet. SAI's analysis shows that use of the Additive has a statistically significant beneficial impact on catalytic conversion efficiencies for all pollutants. See Appendix 3, at pp. 4-5.

Moreover, Ford's laboratory results are suspect because there is no comparative testing on catalysts exposed to gasoline

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Moreover, conspicuously absent from any of the studies on which Ford relies is an attempt to relate the alleged plugging to actual emissions data. Ford does not show, for example, that the reduction in conversion efficiency -- even if accepted at face value -- translates into "real world" pollutant emissions that would cause or contribute to the exceedance of emission standards. This stands in sharp contrast to Ethyl's testing, which was designed to determine the performance of catalysts exposed to the Additive under actual operating conditions, and which shows that use of the Additive does not adversely affect catalyst performance.[63/]

Further, most of the catalysts that Ford analyzed in these studies came from cars which had exhibited "driveability" problems.[64/] One cannot reasonably conclude, therefore, that it was the Additive that caused the reductions in converter

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[62/] (...continued)
without the Additive to show that the alleged catalyst affects are attributable to the Additive. Indeed, a statistical analysis of the Ford data, standing alone, shows that use of the Additive does not have an adverse effect on conversion efficiency. See infra pp. 26-27.

[63/] See Waiver Application, Appendices 2A, 2B, and 3.

[64/] See, e.g., Ford Comments, Attachment 2. Ford also makes references to a Canadian police car catalyst that it analyzed. Id. at p. 2. As noted in Appendix 3, however, plugging in police car catalysts is not uncommon, even in the United States where the Additive is not present in unleaded gasoline. See Appendix 3, Attachment 1 ("Contact with the [U.S.] muffler shop revealed that catalysts are replaced frequently and not just on police vehicles"). In any case, the 5.8 liter police car engine is an "interceptor" engine not available to the general public. It does not represent any particular engine service other than police duty service.

efficiency claimed by Ford. Indeed, Ford itself acknowledges that many of these catalysts had been exposed to extremely high temperatures and other abnormal operating conditions -- conditions known to adversely affect catalyst operation.[65/] Recognizing that the catalyst has been exposed to such abnormal conditions is extremely important, as noted in the comments filed by Imperial Oil of Canada:

> We have never seen a catalyst or oxygen sensor that has failed because of manganese oxide plugging alone. If plugging occurs, it is more likely from gross catalyst overheating caused by an out of tune or mis-calibrated engine. Temperatures can on occasion get so high as to physically melt the catalyst core, and at the same time melt manganese oxide deposits onto the front face of the catalyst. <u>It is easy to erroneously blame MMT when it is not the root cause of the problem</u>.[66/]

This is precisely the conclusion Ethyl finds upon conducting detailed statistical analysis of the data provided in Ford's catalyst studies. Ethyl determined the statistical relationships between the key elements reported by Ford -- namely, conversion efficiency (measured as microreactor activity), BET surface area, precious metal loading, and composition of the coating on the catalysts. This analysis shows that the presence of manganese on the catalysts reviewed by Ford <u>did not affect conversion efficiency</u> and, in fact, improved conversion efficiency for HC

[65/] <u>See</u>, <u>e.g.</u>, Ford Comments, at p. 1.

[66/] Letter to Mary Smith from R.C. Betts, General Manager, Imperial Oil dated July 18, 1990 (EPA advises enroute to the docket) at p.2 (emphasis added).

and CO emissions.[67] Ford erroneously attributes the reductions in catalyst performance to manganese oxide (the most "visible" coating element) rather than the true culprits -- lead, zinc, and barium.[68]

In an independent analysis of the Ford and MECA comments, Charles Heinen -- a former Chrysler engineer, its Director of Research and Materials engineering and its principal technical representative on air, water and solid pollution control for over 20 years -- reaches essentially the same conclusion.[69] Noting that use of the Additive results in catalysts with a reddish coating, Mr. Heinen suggests that this "sometime leads to erroneous first impressions."[70] Following an extensive analysis of the Ford data, he states that the conclusions of the Ford paper are erroneous. In his words, "Mn3O4 does not cause macro or micro plugging which affects catalyst reactions at the Canadian concentrations of 1/16 gram of Manganese per gallon."[71] Contrary to Ford's characterization of its data, Mr. Heinen finds that Ford's data merely shows that:

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[67] See Appendix 4.

[68] Id. Inasmuch as the set of catalysts Ford reviewed was not selected in a scientific, unbiased manner, one cannot attribute the results of Ford's analysis, even properly interpreted, to catalysts generally. Id.

[69] See Appendix 5. Ethyl also responds to MECA's comments in footnote 75 infra at p. 29.

[70] See Appendix 5, at p. 3.

[71] See id. at p. 7.

1. The combustion product of the Additive, Mn_3O_4, slowly forms deposits on the catalyst at a constant rate.

2. There is no indication that Mn_3O_4 enters into any chemical reactions within the catalyst.

3. The Mn_3O_4 coating is porous, and does not appear to interfere with the area on which the chemical reactions of exhaust pollutants occur.[72/]

Finally, Ford claims that the Coordinating Research Council ("CRC") test program completed in 1979 showed that "hydrocarbon conversion efficiencies decrease with increased MMT concentration."[73/] This is plainly inaccurate. The CRC study to which Ford refers concluded that the "catalytic converter efficiency for hydrocarbons was 2 to 3 percent higher with the MMT fuels."[74/] Indeed, on the issue of catalyst plugging, the results of the CRC test program and Ethyl's test program are fully consistent -- the CRC concluded that "[t]here was no indication of catalyst plugging with any of the fuels."[75/] In sum, the studies upon which Ford relies to suggest that additional testing be performed with respect to catalyst plugging

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72/ Id. at p. 7.

73/ Ford Comments, at p. 2.

74/ J.D. Benson, R.J. Campion, and L.J. Painter, "Results of Coordinating Research Council MMT Field Test Program," SAE Paper No. 790706 (1979), at p. 6.

75/ Id.

in no way refute the results of Ethyl's extensive test program.[76/] Inasmuch as Ford has misinterpreted the results of independent

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[76/] The comments of MECA -- an association of catalyst manufacturers that supply catalysts to Ford and Chrysler -- regarding the effects of the Additive on catalysts suffer many of the same flaws as the Ford comments. For example, MECA admits that "most of this research [on the effect of MMT on catalysts] was based on evaluations of higher concentrations than proposed in the Ethyl waiver." Nevertheless, MECA states that "we believe that . . . even at . . . 1/32 grams per gallon," adverse effects could occur. MECA Comments, at p. 1. Similarly, with respect to catalyst coating, MECA states that although the data it offers are based on "a higher concentration . . . [we] believe the risk of coating still exists at a 1/32 concentration." Id. at 2. With respect to catalyst plugging, MECA observes that while the only data it has reviewed reflect higher concentrations, the "mechanism of deposit probably will be lessened, but not eliminated" at lower concentrations. Id. Nowhere does MECA address whether possible coating or "lessened" deposits at lower concentrations will adversely affect exhaust emissions. Like Ford, therefore, MECA's speculation based on older studies does not affect the results of the extensive data and analyses supplied by Ethyl in support of its waiver application.

Otherwise, MECA's comments advance unsupported theories, which MECA makes no attempt to relate to the effect of the Additive on exhaust emissions. For example, with respect to effects on catalyst surfaces, MECA states that "[m]anganese oxides (Mn_2O_3) will readily react with the washcoat alumina" of the catalyst to form spinal. Id. Of note in this regard, Ford and Ethyl are in agreement that the primary combustion product of the Additive is Mn_3O_4, not Mn_2O_3. MECA makes no attempt to explain why Mn_2O_3 is of particular concern. With respect to effects on the ceramic substrate, MECA states that "[i]f the manganese reaches the catalyst substrate in the form of manganese oxide, it can react with the cordierite" in the substrate. Id. at 3. MECA then observes that accumulation of manganese oxides on the washcoat "will interfere with desirable [but unspecified] improvements that are expected to result from current research efforts," but evidently do not exist now. Id. None of these comments change the results of the Ethyl test program -- i.e., that any effects on catalysts were not sufficient to cause or contribute to exceedances of emission standards. MECA's concerns are discussed more fully by Charles Heinen in Appendix 5. In Appendix 2, Ethyl also provides information on Japanese patents for catalytic converters involving the use of manganese as a catalytic agent, a fact not addressed by MECA in their comments. See Appendix 2, at pp. 10-11.

studies (e.g., the CRC study) on the effect of the Additive on catalysts, the Agency should be cautious in according any weight to Ford's characterization of studies that it has conducted itself.[77/]

b. Test fuel

Ford suggests that the results of Ethyl's test program may be unrepresentative of the actual impact of the Additive in commercial operation because Ethyl did not use a test fuel containing detergents.[78/] Ford suggests that the "[l]ack of fuel detergents would cause an increase in the combustion chamber or intake fuel system deposits and thereby result in an unrepresentative baseline as a reference point."[79/] Based on this

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[77/] That the Agency should be cautious in evaluating Ford's characterization of its more recent studies is further confirmed by a study of the Additive's impact on catalysts completed by Ford in 1982 and not cited in its comments. In this study, Ford concludes that use of the Additive enhances catalytic efficiency -- a conclusion directly contrary to the one Ford attempts to advance here. See W.B. Williamson, et al. "Effects of Fuel Additive MMT on Contaminant Retention and Catalyst Performance," SAE Paper No. 821193 (1982).

[78/] Ford Comments, at p. 2. This concern is also expressed by General Motors. See General Motors Comments, at p. 2.

[79/] Ford Comments, at p. 2. Ford asserts that use of Howell EEE is not representative because emissions measured in the Ethyl test program are different from those for the same cars used by Ford in durability test fleets for certification testing using commercial fuels for mileage accumulation. What Ford fails to acknowledge is that the cars used in the certification process are not production vehicles. A difference in emissions is not therefore surprising. See Critical Analysis of the Federal Motor Vehicle Control Program, Northeast States for Coordinated Air Use Management ("NESCAUM")(July 1988) at p. 25 ("The certification process ... must as a practical matter deal with prototype cars (sometimes almost hand made) in an artificial environment (very

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suggestion, Ford goes on to conclude that "[t]herefore, there is some reason to suspect . . . the relative effects of MMT" as observed in the Ethyl test program.[80/] Ford's concern is without merit for several reasons.

First, Ford's argument makes little sense conceptually. Even if use of detergents affected "baseline" emissions, it does not follow that it would also affect the "relative" emission difference between the fuels. Indeed, it probably would not. Howell EEE, the fuel used by Ethyl in the test program, is a very "clean" fuel.[81/] Detergents are used with fuels that are not clean, to minimize formation of fuel system deposits. Since the test fuel was clean, the presence or absence of detergents would not be expected to have a material effect on the formation of fuel system deposits. As a result, they should have little

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79/ (...continued)
careful maintenance, perfect driving conditions, with well-trained drivers using ideal roads or dynamometers, etc.). As a result, one can say with confidence that cars that fail to meet emission standards during certification would have certainly also failed to meet standards in use; however, the converse is not true, i.e., one cannot say with confidence that cars that pass certification will inevitably perform well in use.").

80/ Ford Comments, at p. 2.

81/ This is confirmed by the engine-out data from the clear-fuel vehicles in the test program. The change in engine-out HC, CO, and NOx emissions from 1000 miles to 75,000 miles was insignificant, and shows that Howell EEE fuel could not have caused the formation of deposits in the test vehicles. See Appendix 2, at p. 6.

effect on the "relative" emissions associated with use of the Additive.[82/]

Second, Ford's concern about detergents reflects a fundamental misunderstanding of the test program itself. The test protocol was designed to determine the change in emissions caused by use of the Additive. The critical information to be developed in the test program is the relative difference (i.e., "delta") between clear and Additive-fueled vehicles (not the baseline emissions). After consultation with EPA and the automobile companies, Howell EEE was selected as the test fuel to minimize confounding factors, so as to isolate the relative emissions effect of the Additive.

Third, the relative HC emissions effect observed in the test program even with Howell EEE was extremely small. The use of detergents and other fuel additive packages, especially in commercial gasoline where there is a need for detergents, could contribute to emissions variability. Adding substances that could contribute even slightly to emissions variability would make it less likely that a statistically significant difference in HC emissions would have been detected between the clear fuel and the Additive.[83/]

[82/] In Appendix 2, Ethyl provides photographs of the fuel injectors from vehicles in Ethyl's test fleet. These photographs clearly show that no deposits formed on the fuel injectors.

[83/] The existing certification requirements do not specifically require that detergents be included in the test fuels used by the automobile companies for certification. Detergents, therefore,

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This is especially true if, as certain automobile companies suggest, Ethyl were simply to have used a commercial fuel in its test program.[84/] The composition of commercial fuels varies by season, and from shipment to shipment. There would be no practical way to minimize this variability. Even if Ethyl could have purchased at one time from a single supplier all of the gasoline needed for its test program (well over 100,000 gallons), and could have arranged to store this amount of fuel, that fuel would have deteriorated over the one and one-half year test program.[85/] For these reasons, use of commercial fuel in the test program would have introduced sources of variability avoided by using the Howell EEE fuel.

Finally, the Agency and the automobile companies were fully aware that Ethyl intended to use Howell EEE fuel in its test program.[86/] The auto companies expressed no concern about the test fuel before the test program began. It seems curious, at best, to assert now that the test program should have been designed in ways that would produce less useful information.

[83/] (...continued)
should not be required to be in the test fuels used by waiver applicants. See 40 CFR § 86.113-87 and 86.113-90. Of note, commercial fuel was not used in the CRC test program conducted in 1978-79. See supra note 73.

[84/] See, e.g., Ford Comments, at p. 5; General Motors Comments, at p. 1.

[85/] See Waiver Application, Appendix 3, at p. 13.

[86/] See Appendix 1.

c. Individual model or vehicle results

Ford urges EPA to focus on individual models in its review of the Ethyl statistical analysis, and also to consider the likely impact of emission changes on vehicle certification.[87/]

On the first point, in recognition of the impossibility of testing every car in the national fleet, EPA has always considered an additive in terms of its overall impact on a representative national car fleet.[88/] Because of normal variability in emission results between individual cars, no meaningful information can be derived as to the impact of the Additive by looking at individual cars alone.[89/] Some cars will have higher emissions and some cars will have lower emissions, with or without the Additive. The contribution of the Additive to those emissions can be determined only by statistical analysis of a sufficient sample of vehicles in the fleet.[90/] This is, of course, why Ethyl made a substantial effort to design a test fleet in consultation with EPA and the automobile companies.

Based on this test program, Ethyl has shown that use of the Additive will not cause or contribute to the failure of emission control systems to meet applicable emission standards. No

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87/ Ford Comments, at pp. 2-3.

88/ See Waiver Application, at pp. 42-45.

89/ See id.

90/ Waiver Application, at p. 44.

commentator has directly challenged the results of this statistical analysis.

Nevertheless, in order to draw from its extensive test data as much information as is meaningfully possible, Ethyl also asked RPI to analyze the data on a model-by-model basis. This information is presented in Appendix 2B to the Waiver Application. For the standard of most concern to the auto industry, the HC standard, this analysis shows that the Additive will not cause or contribute to the exceedance of the standard for each individual car model.[91/]

Finally, with respect to the impact of the Additive on vehicle certification, Ethyl in fact conducted such a review of its own accord in conjunction with the waiver application. Ethyl has shown that each of the vehicles used in Ethyl's test program would have been certified even if they had been operated on fuel containing the Additive.[92/]

For all of these reasons, Ford's comment regarding individual vehicle models are without merit.

91/ Waiver Application, Appendix 2B, at p. 30. This analysis shows that, even for the three vehicle models which exceeded the HC standard regardless of fuel type, the variability in HC emissions is such that the difference in exceedance mileages between the two fuels is indistinguishable from zero. This statement is true for each individual car model (i.e., T, F, and D) and is also true when the exceedance mileages for the three car models are pooled. Since there is no statistically significant difference in exceedance mileage, one must conclude that HiTEC 3000 does not cause or contribute to exceedances of the HC emission standard -- either on a car model by car model basis or on the basis of the fleet data. Id.

92/ See Waiver Application, Appendix 2A, at pp. 48-49.

d. Emission/maintenance issues

Ford claims that vehicle emissions improved after maintenance adjustments to the vehicle engines, and, therefore, that these improvements are not attributable to use of the Additive.[93/] Ethyl specifically considered this issue in its waiver application, so as not to take credit for any emission reductions that were not attributable specifically to use of the Additive. This analysis is presented in Appendix 2A to the Waiver Application, and shows that any emission changes attributable to maintenance of the vehicles do not change the conclusions of the statistical analyses.[94/]

e. NOx emissions

Ford asserts that "[t]here appears to be no definitive explanation for the NOx reduction" in the test program.[95/] The two independent statistical experts who analyzed the test program data, however, attribute the reduction in NOx emissions to use of the Additive.[96/] To date, no one, not even Ford, has disputed the results of these independent statistical analyses. Moreover, no other automobile manufacturer, domestic or foreign, challenges

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93/ Ford Comments, at pp. 2-3.

94/ See Waiver Application, Appendix 2A, Attachment G.

95/ Ford Comments, at p. 3.

96/ See Waiver Application, Appendices 2A and 2B.

the conclusion that use of the Additive reduces the emission of both CO and NOx.[97/]

Without addressing the results of the test program or statistical analyses, Ford attempts to support its allegation that the Additive does not contribute to NOx and CO reductions by offering several alternative explanations as to why emission reductions were observed in the cars using the Additive.[98/] None of these alternatives withstand analysis.

> Alternative Theory No.1 -- Ford alleges that "Mn3O4 deposits in the combustion chamber create 'hot spots' which affect the ignition point and serve to both decrease NOx and increase HC."[99/] This theory is inconsistent with Ford's own assessment of the engine-out data. For example, at 50,000 miles, the engine-out NOx emissions are listed as higher for the Ford Escorts using fuel containing the Additive, even though tailpipe emissions were substantially lower in these vehicles when compared to Escorts using clear fuel.[100/]
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> Alternative Theory No. 2 -- Ford alleges that the "[o]xygen sensors coated with Mn3O4 can change the engine air/fuel mixture from that intended by the engine design."[101/] This theory is inconsistent with the testing conducted by Ethyl to determine the impact of the Additive on operation of the oxygen

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97/ For example, Chrysler states that "[c]arbon monoxide (CO) and oxides of nitrogen (NOx) emissions were reduced." Chrysler Comments, Technical, at p. 1.

98/ Ford Comments, at p. 3.

99/ Id. (emphasis added).

100/ Id., Attachment 5, Table 2.

101/ Ford Comments, at p. 3.

sensors.[102] It is also inconsistent with the engine-out data for the test vehicles. These data show that a substantial reduction in NOx occurs after NOx emissions leave the engine. The only plausible explanation for this reduction in NOx emissions is catalytic activity in the exhaust system.[103]

Alternative Theory No. 3 -- Ford alleges that "Mn3O4 deposits on the fuel injectors may alter the spray patterns and/or prevent closure, thus increasing enrichment in one or more cylinders, leading to increased HC emissions, subsequently decreased NOx, and possible imbalance in engine power generation."[104] As with the two theories noted above, this theory is not consistent with the engine-out data for the test vehicles. These data show that a substantial reduction in NOx occurs after measurement of the engine-out emissions. This reduction can only be attributed to catalytic activity.[105]

Alternative Theory No. 4 -- Ford alleges that "Mn3O4 deposits on the catalyst washcoat can lead to increased backpressure which will increase residual gas in the engine, thus increasing HC emissions and decreasing NOx emissions and possibly affecting vehicle performance."[106] This theory is again inconsistent with the engine-out data from the test fleet. It is also inconsistent with the back pressure testing conducted by Ethyl

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[102] Waiver Application, Appendix 3, at pp. 2-3.

[103] See Ethyl Comments, Appendix 9.

[104] Ford Comments, at p. 3.

[105] See supra p. 37. Moreover, photographs of the fuel injectors from the vehicles in Ethyl's test fleet using fuel containing the Additive show that no deposits formed on the fuel injectors. See Appendix 2, Attachment 3.

[106] Ford Comments, at p. 3.

which showed that use of the Additive did not increase back pressure.[107/]

In sum, the theories proposed by Ford to explain the drop in NOx emissions are inconsistent with the undisputed results of Ethyl's test program.[108/] The better theory is the one proposed by Dr. Harrison and others -- i.e., that Mn3O4 deposits in the manifold and exhaust system may act as a catalyst for NOx and CO emissions.[109/]

f. Engine-out data

Ford also asserts that the engine-out data is inconsistent with the claim that Mn3O4 deposits in the exhaust system are responsible for a decrease in tailpipe NOx emissions.[110/] Ford is simply wrong in this regard. Ethyl calculated the conversion efficiency of seven of the eight vehicle models used in the test

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[107/] See Waiver Application, Appendix 3, at p. 5. General Motors notes in its comments that a theory "for the lower NOx emissions . . . could be an increase in exhaust system back pressure," but then observes, in apparent refutation, that "Ethyl's waiver request reported no converter back pressure increase." General Motors Comments, at p. 3.

[108/] Ford asserts that "[i]t is this uncertainty in the mechanism for NOx reduction which makes a greater in-depth analysis so critical in order to determine what is occurring within the vehicle emission control system." Ford Comments, at p. 3. As noted above, however, this alleged "uncertainty" is based on an inaccurate understanding of the test data. There is, therefore, no need to conduct the additional testing desired by Ford.

[109/] See Ethyl Comments, Appendix 9.

[110/] Ford Comments, at p. 3.

program.[111] These conversion efficiencies represent a ratio of engine-out emissions/tailpipe emissions. As such, the conversion efficiencies provide an objective measure of the performance of catalytic converters, independent of any engine-out emission effects attributable to the Additive. Ford's claim regarding NOx engine-out emissions is inconsistent with the fact that the average NOx conversion efficiency of the vehicles using fuel containing the Additive was better than that for those vehicles using clear fuel.[112]

Indeed, as noted above, the engine-out data from the test vehicles show that the better explanation for the reduction in tailpipe NOx emissions is catalytic activity in the manifold and exhaust system. Again, the experience with the Ford Escort is relevant: while engine-out NOx emissions were higher on average for the Escorts using fuel containing the Additive, tailpipe emissions from those same vehicles were lower when compared to the Escorts using clear fuel.[113] The better explanation for this result is catalytic activity associated with Mn_3O_4 deposits in the catalyst and other parts of the exhaust system.[114]

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[111] Waiver Application, Appendix 3. Ethyl was not able to measure engine out emissions from car model F because the catalyst is so closely-coupled to the manifold in that vehicle model. See id. at p. 4.

[112] Id.

[113] See supra p. 37.

[114] See Ethyl Comments, Appendix 9.

g. Testing of light-duty trucks

Ford also suggests that Ethyl should have included light-duty trucks in its test program.[115/] As noted above, EPA has recognized that testing of every vehicle in the national fleet would be an impossible burden.[116/] Therefore, choices must be made in the design of a test protocol as to what vehicles, engine types, and pollution control systems will be represented. In light of these considerations, Ethyl designed its test protocol in close consultation with the Agency and with full knowledge of the automobile companies. During these discussions, the issue of light duty trucks was raised, but the decision was made to include other more widely used car models.[117/] Before now, none of the automobile companies disagreed with this conclusion or suggested that Ethyl should consider including a light duty truck in the test fleet.[118/]

As a practical matter, however, including a light duty truck in the test fleet would not change the results of the analysis.

115/ See Ford Comments, at p. 4. Chrysler and General Motors assert the same concern. See Chrysler Comments, Technical, at p. 7; General Motor Comments, at p. 3. Chrysler apparently also expressed a concern that the fleet did not include heavy-duty trucks. See Memorandum to Docket, entry IV-E-4.

116/ See supra note 8.

117/ See Appendix 1. Included in the series of meetings with EPA concerning design of the test protocol (which are summarized in the letter to Richard Kozlowski dated July 19, 1988) was a meeting on February 10, 1990 at which the issue of light-duty trucks was specifically addressed.

118/ See id.

The test results would likely be the same because some of the models used in the Ethyl test fleet have the same engines used in light duty trucks (e.g., models D, F, H, T, and possibly others), although the calibrations and catalyst type and location may be different in the truck body. Since light duty trucks are certified using the same driving schedule as the passenger cars, there is no reason to believe that these trucks would show emission deteriorations different than the passenger cars used in Ethyl's test fleet.

Moreover, by including two models with close-coupled catalysts, and by testing one of these models for plugging under high speed operating conditions, Ethyl has shown that plugging is not a concern even under the more severe operating conditions alleged to be associated with use of light duty trucks. Ford's speculation as to what "might have been" included in the test program over two years after the fact should be given no weight.[119/]

h. Evaporative emissions

Finally, Ford urges EPA to consider the Additive's impact on evaporative emissions. Ethyl does not disagree, and in fact conducted testing to determine what impact use of the Additive would have on evaporative emissions. This analysis, presented in Appendix 3 to the Waiver Application, shows that use of the

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[119/] It should be noted, however, that Ethyl is willing to work with EPA and the automobile companies to continue to evaluate the Additive in commercial use after approval of its application. See infra pp. 50-51.

Additive would not adversely affect evaporative emissions.[120/]

2. Chrysler

Chrysler observes in its comments that it "devotes considerable time, effort and resources to engineering its vehicles to meet emission regulations," and suggests that use of the Additive would frustrate its considerable and careful efforts.[121/] While Chrysler states that it has "major concerns" with the waiver application,[122/] it studiously avoids commenting on the detailed statistical analyses showing that the Additive does not cause exceedances of emission standards.[123/] Were Chrysler truly concerned about meeting emission standards, it would give this analysis, and the significant emission reductions

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120/ See Waiver Application, Appendix 3. Once again, Ford points to a "potential" concern, evaporative emissions, but makes no effort to respond to Ethyl's analysis in this regard. The Agency should give little weight to a commentator who fails to acknowledge the analyses conducted by Ethyl.

In this regard, it should be noted that the foreign automobile manufacturers' brief comments similarly reflect a failure to review Ethyl's application, in favor of making broad and unsupported allegations. See, e.g., Toyota Comments, at p. 1 ("Although we have no recent data for . . . 1/32 g/gallon Mn," Toyota still believes HC emissions could be adversely affected.); Nissan Comments, at p. 1 ("Nissan does not have any emissions durability data" regarding the Additive, but nevertheless is concerned that the Additive may cause adverse effects.). In light of the results of Ethyl's extensive test program, such comments are entitled to no weight.

121/ Chrysler Comments, Technical, at p. 6.

122/ Id. at 1-2.

123/ See Waiver Application, Appendices 2A and 2B. Since Chrysler has so obviously ignored the extensive studies and analyses supporting Ethyl's waiver application, its comments, like those of Ford, should be given little weight.

that could be achieved with use of the Additive, more attention.[124/]

The following discussion reviews Chrysler's "major" concerns about use of the Additive.[125/] For the reasons discussed below, these concerns have already been addressed in the materials supporting the waiver application, and are unfounded.

[124/] In this regard, Chrysler, in its "legal memorandum," attempts to argue that many of the environmental and other effects that Ethyl has demonstrated would be associated with use of the Additive are irrelevant in this proceeding. Chrysler Comments, Legal Memorandum, at p. 8. While Ethyl would agree that the principal burden it must meet under § 211(f)(4) relates to the "cause or contribute" standard, environmental, economic, and energy considerations are at least relevant through the purposes clause of the Act. See Waiver Application, at pp. 60-62. Chrysler has not addressed this aspect of the waiver application, and indeed is inconsistent in its own comments where it suggests that public health is a relevant consideration. See Chrysler Comments, Technical, at pp. 6-7.

Chrysler also attempts to argue, as do certain foreign manufacturers, that any increase in HC emissions, however small, is grounds for denying the application. See e.g., Chrysler Comments, Legal Memorandum, at p. 7; Toyota Comments, at p. 2. As Ethyl has explained, this is simply not the statutory standard. See supra note 30. While Chrysler characterizes the case law as rejecting the concept that an additive that causes "significant failures" can still be approved for use, see Chrysler Comments, Legal Memorandum, at 5. n.4, this is not a principal that Ethyl has ever advanced in its waiver application. Rather, Ethyl has shown that EPA's two part test would be met here -- i.e., that the Additive would not cause "significant adverse effects," and that it would not "cause or contribute" to failure of applicable standards. See Waiver Application, at pp. 15-24. Ethyl has never argued, and indeed has no need to argue (contrary to the implication of the Chrysler legal memorandum), that an additive that "causes or contributes" to the failure of an emission standard can still be approved if the failure is not "significant."

[125/] To the extent Chrysler raised concerns also raised by Ford, these concerns are addressed in the appropriate sections dealing with Ford's comments. See supra at pp. 22-40.

a. In-use driving conditions

Chrysler expresses concern that "Ethyl's tests may not be reproducible in actual in-use conditions over the useful life of the vehicle."[126/] In particular, Chrysler suggests that the test procedure did not adequately reflect certain driving conditions.[127/] This concern is somewhat surprising insofar as Ethyl used the same test procedures, the Federal Test Procedure (FTP), used by the automobile companies to certify vehicle prototypes under the Act. For the Agency to give any weight to this comment, therefore, would call into question over 20 years of certification test results.

The automobile industry cannot have it both ways -- arguing that use of the FTP is inadequate for waiver applications, but adequate for certification testing. In any case, the FTP as applied in the Ethyl test program does reflect typical, in-use driving conditions. The FTP as applied in the Ethyl test program is the same as that specified by EPA's certification regulations.[128/]

Even though the driving conditions in the Ethyl test program reflect typical in use conditions, Ethyl conducted additional testing using the Additive under more strenuous conditions.[129/]

126/ Chrysler Comments, Technical, at p. 6.

127/ Id.

128/ See 40 C.F.R. Part 85 et seq.

129/ See Waiver Application, Appendix 3.

Even under these more strenuous conditions (high speed, high temperature driving in vehicles equipped with close-coupled catalysts), use of the Additive did not cause plugging of the catalytic converter or otherwise adversely affect catalytic operation.[130/]

b. Prior studies of catalyst plugging

Chrysler selectively quotes from several studies which address whether use of the Additive causes plugging in catalysts.[131/] None of these studies, however, refute -- directly or indirectly -- Ethyl's test program results showing that use of the Additive will not cause catalyst plugging. Each of these studies is addressed in turn below.

1. SAE Paper Nos. 770655 and 780004 -- These studies were conducted on vehicles equipped with oxidation catalysts (1) using fuel containing concentrations of the Additive up to 400 percent higher than requested in this waiver application, and (2) having an inlet gas temperature much higher than that for three-way catalysts. Moreover, Chrysler omits any reference to another early

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130/ Id. This comment provides yet a further instance where an auto company calls for additional testing without having reviewed Ethyl's test program to determine whether Ethyl had conducted the testing requested. Chrysler also comments, for example, that "Ethyl should have addressed" how the Additive would affect vehicles equipped with close-coupled catalysts under high-speed driving conditions. Chrysler Comments, Technical, at p. 6. This precisely describes one of the tests Ethyl conducted. Waiver Application, Appendix 3, at pp. 5-6. Yet, Chrysler makes no attempt to comment on the results of that test. The only plausible explanation for this incongruity is that Chrysler has not carefully reviewed the waiver application. The Agency should be cautious in according weight to such comments.

131/ Chrysler Comments, Technical, at p. 2.

study, "An Evaluation of Manganese as an Antiknock in Unleaded Gasoline," SAE Paper No. 750925 (1975), which showed that even under high temperature conditions, monolith catalysts did not plug using the Additive at 0.0625 grams manganese/gallon.

2. SAE Paper No. 890582 -- As noted in Ethyl's Comments of July 23, the conclusions presented in this paper ignore the effect of potential misfueling and lead content on catalysts. High lead concentrations are known to deactivate noble metal catalysts, and may have had that effect on the catalysts analyzed in this paper. Second, this paper assumed that all of the test vehicles were operated under normal conditions, with proper routine maintenance. Neither of these conclusions is substantiated in the paper. Finally, as noted with respect to the Ford studies on plugging,[132] the catalyst conversion efficiencies reported were based on laboratory methods for which no correlation with actual field emissions testing is shown.[133]

3. Update on MMT as Related to Canadian Gasolines -- This quote from an Ethyl paper does not state that the Additive causes plugging, only that "monolithic catalysts experience plugging" when closely-coupled and subjected to abnormal operating conditions. Contrary to the impression Chrysler attempts to convey, Ethyl does not believe use of the Additive at the concentration requested will cause plugging in catalysts, even those closely-coupled to the manifold.

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[132] See supra pp. 24-25.

[133] Ethyl Comments, at pp. 51-52.

Chrysler also refers to catalysts that it sent to Ethyl for review.[134/] Chrysler's claims to the contrary, none of these catalysts was plugged. While they all exhibited varying levels of manganese deposition, this does not, by itself, provide evidence of plugging. Of note, Chrysler provides no data (e.g., back pressure tests, conversion efficiencies) from which one may scientifically conclude that the Additive caused plugging in these catalysts. Chrysler's concern regarding catalyst plugging associated with use of the Additive is unfounded.[135/]

c. Testing approach

Chrysler also asserts that Ethyl should have run its test program to 100,000 miles.[136/] This comment is unfounded for several reasons. First, Ethyl did, in fact, conduct 100,000 mile testing on four Chevrolet Corsicas. After 100,000 miles of operation, the vehicles operating on fuel containing the Additive had back pressure measurements which were no different than the vehicles using clear fuel, and as good or better converter efficiencies.[137/]

Second, all of the test cars were certified to 50,000 miles, not 100,000 miles. The Agency's waiver application guidelines do

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134/ Chrysler Comments, Technical, at p. 4.

135/ See Appendix 5.

136/ Chrysler Comments, Technical, at p. 6.

137/ Waiver Application, Appendix 3, at pp. 6-7.

not require applicants to test beyond the certification period[138/] and, indeed, it was questionable whether some of the cars in the fleet, particularly the Chrysler vehicles, could have been operated all the way to 100,000 miles without substantial mechanical overhauls.

Third, despite the Agency's waiver application guidelines, Ethyl did extend the testing beyond 50,000 miles to 75,000 miles. This modification in the test program was adopted specifically to address the possibility of extended warranty and emission standard provisions of proposed amendments to the Act. This testing established clear trends in the emissions data, showing little change in HC emissions after 50,000 miles (and perhaps even a slight decrease in the relative HC emissions of cars fueled with the Additive), and continuing decreases in the relative NOx and CO emissions in cars using the Additive.[139/] There is nothing in the test data to suggest that this trend would not have continued beyond 75,000 miles. Moreover, Ethyl specifically consulted the automobile companies on whether to extend the testing beyond 75,000 miles, and was advised that this would not be important.[140/]

Finally, 100,000 mile testing using the one Chrysler car in the test fleet would not have been helpful, because the Chrysler

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138/ 43 Fed. Reg. 11258.

139/ Waiver Application, Appendix 2A and 2B.

140/ See Appendix 1 (memorandum from Gary Ter Haar).

vehicle failed emission standards so miserably and so early using clear fuels.[141/] As a result, testing to 100,000 miles would not likely have produced a result different from that associated with the 50,000 mile and 75,000 mile data.

For all of these reasons, testing to 100,000 miles is neither required nor appropriate.

3. General Motors

As noted above, General Motors has recommended that the Agency approve Ethyl's waiver application, subject to monitoring of the impact of the Additive in actual use and in light duty trucks.[142/] With these reservations regarding on-going testing, General Motors does not challenge that Ethyl has satisfied the legal standard for approval of its waiver.

With respect to General Motors' request for a condition requiring monitoring the Additive in actual use and in light duty trucks, Ethyl believes that any additional evaluations will produce results no different from those associated with the comprehensive test program already completed. Nevertheless, Ethyl is willing to work with the Agency and others after approval of its application to define reasonable and appropriate programs for additional evaluation of the Additive. It would be inappropriate to attempt to define the details of such additional

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141/ Id., Appendix 2A, at B-25 and B-41.

142/ General Motor Comments, at p. 1. Such monitoring could possibly address General Motors suggestion that the effect of the Additive on emissions may vary depending on the metal used to construct engine cylinder heads. See id. at 4.

programs in the context of this waiver proceeding, however, given the time constraints in this proceeding and the many complex issues already before the Agency for evaluation.[143/]

IV. CONCLUSION

As the preceding discussion shows, Ethyl has affirmatively established that the Additive will not cause or contribute to the failure of emission control devices to meet applicable standards. Ethyl's extensive test program and the statistical analyses of the resulting data also resolve the questions raised by the automobile companies and other commentators. In light of Ethyl's test data, and the information submitted by Ethyl showing that approval of this application will promote the public health and welfare and the productive capacity of the nation, this application should be promptly approved.

143/ Ethyl notes that the Agency has authority under CAA § 211(c) to regulate fuel additives after a waiver is granted. This provision gives the Agency authority after the waiver is granted to conduct any additional evaluations of the Additive that are reasonable and appropriate.

A-90-16
IV-D-A22
(112)

ETHYL CORPORATION
GOVERNMENT RELATIONS
1155 Fifteenth Street, N.W., Suite 611
Washington, D.C. 20005
(202) 223-4411

Lt. Gen. Jeffrey G. Smith, U.S.A.(Ret.)
Director of Government Relations

10 August 1990

Mr. William K. Reilly
Administrator
The United States Environmental
Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Re: Ethyl HiTEC® 3000, Docket A-90-16

Dear Mr. Reilly:

Enclosed are supplemental comments in support of Ethyl Corporation's May, 9, 1990 waiver application. These comments are specifically addressed to automobile industry comments which were filed at the end of the formal comment period, allowing Ethyl no opportunity to review and respond until this time. Your staff, however, has assured us that filing by this date would afford timely consideration of our views.

Ethyl anticipates commenting further, where appropriate, on any further waiver-related comments not presently in the docket.

In particular, Ethyl intends to respond to comments, dated 23 July 1990, which were submitted by two employees of the National Institute of Environmental Health Sciences. Those comments have not yet been placed in the docket, and Ethyl was only recently made aware of them.

Sincerely,

Jeffrey G. Smith

A-90-16
IV-D-112

Ethyl Petroleum Additives Division
20 South 4th Street
St. Louis, MO 63102-1886
(314) 421-3930

July 19, 1988

Mr. Richard G. Kozlowski
United States Environmental Protection Agency
401 M. Street, S.W.
Washington, DC 20460

Dear Mr. Kozlowski:

Approximately eight months ago Ethyl Corporation began discussing the feasibility of a request for a waiver to add MMT™ Antiknock Compound to unleaded gasoline with representatives of the Environmental Protection Agency. Since the initial meeting we have discussed many details. This letter is written with the intent of reviewing the conclusions of the those meetings and inviting comments. Any guidance which you may offer will be greatly appreciated.

Specifically, we would like to address the following topics:

A) Test Fleet Selection

Following a thorough review of published 1987 vehicle sales and production information with the respective automobile manufacturers we selected the fleet shown in Attachment A. This information was reviewed with EPA representatives on February 10, 1988. As a point of comment we were forced to change model/body styles of the General Motors Chevrolet Corsica to a Chevrolet Cavalier due to the non-availability of the Corsica. The specific engine type (2.01 LL8) remained unchanged.

B) Test Site Selection

Due to the overall size of the aforementioned test fleet we elected to use two test sites. Each site will test an equal number of vehicles. The sites chosen are ECS Laboratory, Inc. located in Livonia, MI and Automotive Testing Laboratory, Inc. (ATL) located in South Bend, IN. The laboratories will cross reference emission results via blind testing of standard reference gases. It should be noted that while both sites use an approved durability mileage accumulation procedure as presented in OMS Advisory Circular No. 37A, ECS uses actual highway operation and ATL uses a test track. Details of each route are included in Attachment B.

C) Test Protocol

In all of our meetings this topic has received a great deal of attention. Test protocol details have been reviewed with EPA representatives in Ann Arbor and Washington as well as reviewed in principle with the respective automobile manufacturers. An outline of the final test protocol is shown in Attachment C-1. It should be noted that based on EPA input we are draining and refilling fuel tanks to a 40% volume level and not performing the diurnal soak when measuring tail-pipe emissions at the selected mileage intervals. All maintenance will be at the manufacturers recommended mileage. Due to inherent exhaust system design of various vehicles, we are unable to obtain mini-CVS emission data in a reliable manner on all the vehicles. Therefore, that data will not be routinely collected.

In our previous discussions we invited EPA personnel to observe the "pairing" process of the test fleet. That process is now underway and the first group of vehicles are shown in Attachment C-2. Based in the emission performance of the six vehicles at the 0 and 1000 mile points, we opted for random "pairing" and will probably continue to do so for the remaining 42 vehicles.

D) Fuel

All reference (clear) fuel will be Howell "EEE" Unleaded Gasoline conforming to the specifications shown in Attachment D. The test fuel will be a blend of Howell "EEE" and MMT™ Antiknock Compound at a level of 0.0312 g Mn/gallon.

The reference fuel will be used in all emission testing as per suggestion from the vehicle manufacturers and EPA.

As a note, we have no plans to add a gasoline detergent to the fuel unless we notice a deterioration in fuel injector performance.

E) Miscellaneous

As the addition of MMT™ to unleaded gasoline in this program will not affect the physical properties of the fuel, specifically its volatility, we are not planning any evaporative emission testing. Further, we are not planning any fuel compatibility testing especially in light of the eleven years of successful use of MMT™ in Canadian unleaded gasoline.

The culmination of this program will provide an extensive database on the performance of current technology automobile gasoline engines using unleaded gasoline containing MMT Antiknock Compound. It is our goal to demonstrate that the use of MMT in unleaded gasoline will not cause or contribute to failure of any emission control devices or systems over the useful life of vehicles in which such devices or systems are used to achieve compliance with the Clean Air Act, Section 206 emission standards. We will also obtain data to demonstrate to the vehicle/engine manufacturer that the use of MMT does not negatively effect the operation of the engine itself.

The use of MMT Antiknock Compound in unleaded gasoline may actually provide benefits to the environment. The proposed rulemaking to reduce gasoline vapor pressure in summer months represents a serious concern to the U.S. refining industry. During the lead phasedown refiners increased refining unit operating severity to make up the lost octane (s). This move generates more light hydrocarbons and increases the Rvp of the gasoline MMT provides octane to gasoline without raising its Rvp and may, in some cases, actually enable refiners to economically lower gasoline Rvp.

Inasmuch as the above issues represent key points of discussions which EPA had previously commented on, this letter is primarily a review. Based on the premise, we have already initiated the test program. We welcome your comments and look forward to discussing this with you at your convenience. We would appreciate any new comments or suggestions, as soon as possible, if they are desired to be incorporated in the test program.

J.M. McChesney
Senior Product Manager

JMM/mll

Attachment A

Vehicle Information

Manufacturer	Model	Engine	Body Style
Chrysler/Dodge	Dynasty	3.0l,V6	CDH41
Ford	Escort GL	1.9l,L4	P21
	Taurus L	3.0l,V6	P50
	Crown Victoria	5.0l,V8	P73
General Motors	Cavalier	2.0l,LL4	
	Century	2.5l,LR8	H19
	Century	2.8l,LB6	H19
	Century	3.8l,LG3	H19

VEHICLE FLEET -- CHRYSLER CORPORATION

CALENDER YEAR 1987	PRODUCTION 1/1-12/26	PERCENT ENGINE BY SIZE AND TYPE BY MODEL FOR TOTAL DOMESTIC				
		2.5L L-4	4.2L L-6			
Alliance	15944					
Encore	0					
Total Renault	15944					
Eagle	0					
Total AMC	15944	0.20%	0.63%			
AMERICAN MOTORS	15944					
		2.2L L4	2.2L L4 TURB	2.5L L4	3.0L V6	5.2L V8
Horizon	45363	0.65%				
Sundance	89157	1.14%	0.13%			
Turismo	0					
Reliant	135036	1.25%		0.67%		
Caravelle	42861	0.21%	0.10%	0.31%		
Fury	7150					0.10%
Total Plymouth	417408					
Laser	0					
LeBaron E	63753	0.23%	0.22%	0.45%		
LeBaron J	113596		0.57%	1.05%		
LeBaron GTS	37118	0.06%	0.26%	0.21%		
Fifth Avenue	64273					0.92%
New Yorker B&C Class	75844		0.76%	0.33%		
Total Chrysler	354584					
Omni	39785	0.57%				
Shadow	95543	1.16%	0.20%			
Lancer	22865	0.04%	0.12%	0.16%		
Daytona	63214		0.45%	0.45%		
Aries	126067	1.80%				
Diplomat	14945					0.21%
Dodge 600	39636	0.09%	0.14%	0.34%		
Total Dodge	410474					
CHRYSLER MOTORS	1084580					

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VEHICLE FLEET -- FORD MOTOR COMPANY

CALENDER YEAR 1987		PRODUCTION 1/1-12/26	PERCENT ENGINE BY SIZE AND TYPE BY MODEL FOR TOTAL DOMESTIC FLEET							
			1.9L L4	2.3L L4 PFI	2.3LL4 TBI	2.5L L4	3.0L V6	3.6L V6	5.0L V8 HP	5.0L V8
Escort		390919	5.57%							
Mustang		212272		1.66%						
Tempo		144427			2.06%				1.36%	
Taurus		403859				1.29%	4.46%			
Thunderbird		155798				0.29%		1.50%	0.43%	
LTD		0								0.00
Crown Victoria	S	82732								1.18
Total Ford Division		1307275								
Lynx		21352	0.30%							
Topaz		46582			0.66%					
Sable		121358					1.38%	0.35%		
Cougar		137356						1.51%		0.44
Capri		0								
Marquis	S	2510								0.04
Grand Marquis	S	77511								1.10
Total Mercury		326883								[illegible]
Continental		13474								0.19
Lincoln		140567								2.00
Mark VII		28248								0.40
Total Lincoln		182289								
Total L-M Division		509172								
FORD MOTOR CO.		1816447								
			5.57	1.66	2.72	1.58	5.84	3.36	1.79	5.35

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VEHICLE ...ET -- GENERAL MOTORS CORPORATION

PERCENT ENGINES BY SIZE AND TYPE BY MODEL FOR TOTAL DOMESTIC FLEET

CALENDAR YEAR 1987	PRODUCTION 1/1-12/26	2.0L 4 LT2	2.0L 4 LL8	2.5L 4 LE?	2.5L 4 LR8	2.8L V6 LB6	3.0L V6 LN7	3.8L V6 LG3	4.1L V8	4.5L V8	5.0L V8 ?	1.6L L4	4.3L V6	5.7L V8
						3.1L LO4		3800						
Skyhawk	34052		0.46%											
Regal	40235					0.51%								
Somerset	62509			0.69%			0.21%							
Century	152152				1.03%	1.09%								
LeSabre fwd/rwd	150924							2.15%						
Electra	93678							1.33%						
Riveria	13242							0.19%						
Total Buick	547252													
Cimarron	10233							0.15%						
Allante	4610								0.07%					
Seville	21130									0.30%				
Deville	141129									2.01%				
El Dorado	20243									0.29%				
Brougham	75141										1.07%			
Total Cadillac	272486													
Chevette	0													
Nova	140725											2.00%		
Cavalier	310678		3.38%			0.44%								
Citation	0													
Camaro	120532					0.67%					1.05%			
Celebrity	283320				1.21%	2.22%								
Corsica/Baretta	345405		3.44%			1.48%								
Monte Carlo	72041										0.62%		0.41%	
Caprice	198935										2.42%		0.42%	
Corvette	28182													0.40%
Total Chevrolet	1359993													
Firenza	14181	0.20%												
Calais	113679				1.27%		0.35%							
Cutlass Ciera	108395				0.84%	0.70%								
Cutlass Supreme	73126							0.25%			0.76%			
Olds 88 fwd	176936							2.52%						
Olds 88 rwd	15000							0.21%						
Olds 98	72038							1.03%						
Toronado	15209							0.23%						
Total Oldsmobile	593162													
Fiero	33434				0.22%	0.26%								
One Thousand	0													
Sunbird	88217	1.26%												
Firebird	77032					0.46%					0.51%			
Grand Am	245955			2.53%	0.93%									
6000	67495				0.47%	0.49%								
Parisienne	9106							0.13%						
Grand Prix	0													
Bonneville	122824							1.76%						
Total Pontiac	645064													
GENERAL MOTORS	3417957													
		1.86	7.4	3.22	5.40	7.32	.56	9.99	.1	2.6	6.56	2.0	.83	.40

19

51.27%

pellethos case

Attachment B

ECS LABORATORIES, INC.

MILEAGE ACCUMULATION ROUTE

LOCATION OF TURN	LOCATION OF SPEED CHANGE	ODOMETER	SPEED LIMIT (MPH)
ECS LABORATORIES (START) SOUTH		0.0	25
PLYMOUTH ROAD WEST		0.5	40
	ENTERING BUSINESS AREA	2.7	35
MAIN STREET SOUTH		3.4	25
	ANN ARBOR TRAIL	4.9	35
JOY ROAD EAST		5.4	40
HAGGERTY ROAD NORTH		6.7	35
ANN ARBOR TRAIL EAST		7.7	35
INKSTER ROAD SOUTH		14.9	40
FORD ROAD EAST		16.5	40
OUTER DRIVE NORTH			
WARREN ROAD EAST		20.7	35
EVERGREEN ROAD NORTH		21.8	30
OUTER DRIVE EAST		26.2	35
6 MILE ROAD EAST		27.7	35
SOUTHFIELD EXPRESSWAY SOUTH		28.4	55
I-96 WEST		30.9	55
I-275/96 NORTH		42.2	55
M102 SOUTH/EAST		49.2	55
FARMINGTON EXIT AT 9 MILE EAST		51.5	35
FARMINGTON ROAD NORTH		51.8	35

MILEAGE ACCUMULATION ROUTE

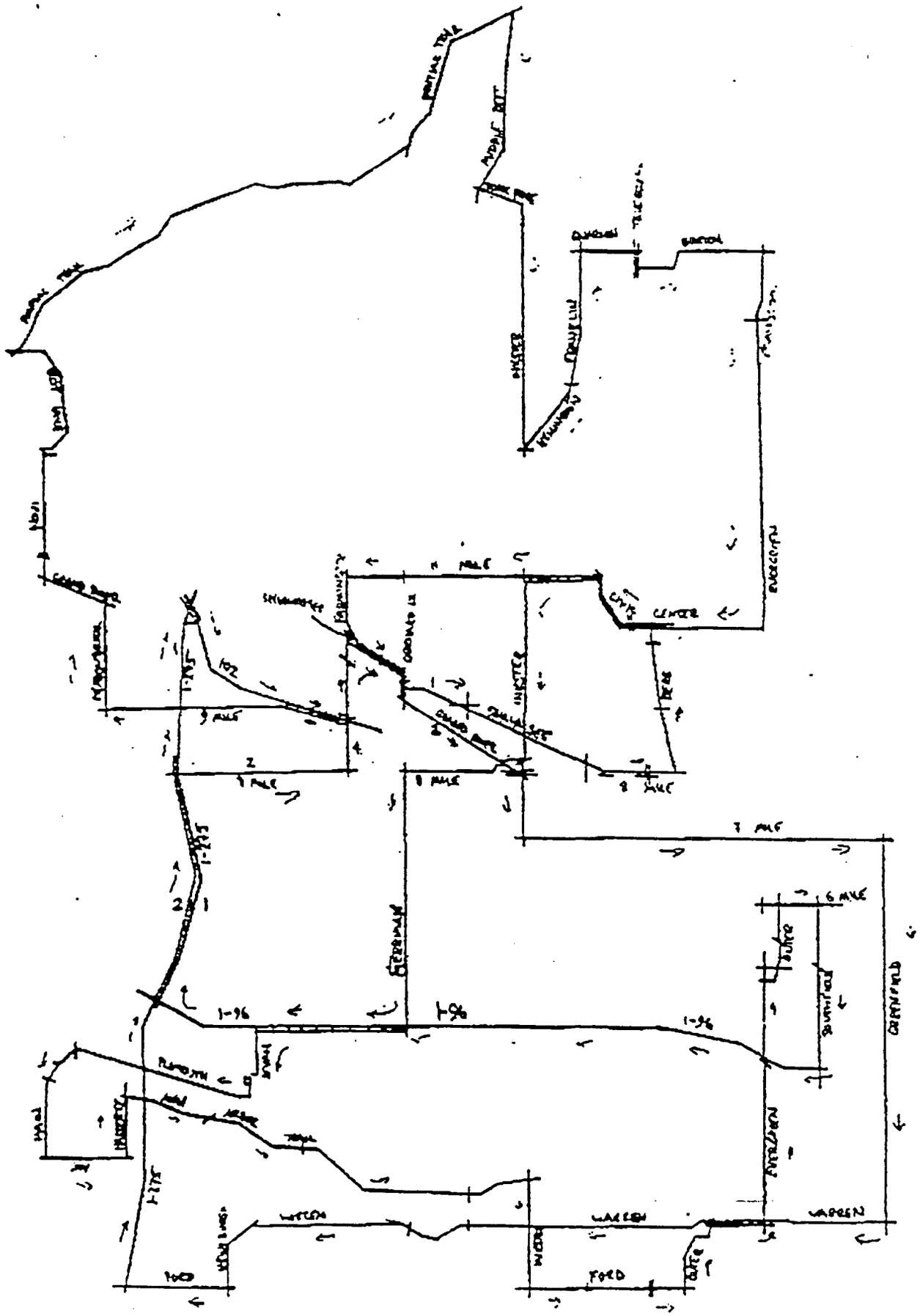
LOCATION OF TURN	LOCATION OF SPEED CHANGE	ODOMETER	SPEED LIMIT (MPH)
	ENTERING BUSINESS AREA	52.1	25
SHIAWASSEE ROAD EAST		52.7	25
	TUCK ROAD	54.2	35
	INKSTER	55.9	30
8 MILE ROAD EAST		57.4	45
BERG ROAD NORTH		58.8	30
CIVIC CENTER DRIVE WEST		61.4	35
11 MILE ROAD WEST		62.3	45
FARMINGTON ROAD SOUTH		66.6	45
	10 MILE ROAD	67.6	25
SHIAWASSEE ROAD EAST		67.9	25
ORCHARD LAKE ROAD SOUTH		68.7	30
GRAND RIVER EAST		69.1	35
	EXIT BUSINESS AREA	69.6	45
INKSTER ROAD SOUTH		71.3	40
7 MILE ROAD EAST		72.1	35
	EVERGREEN	76.1	30
GREENFIELD ROAD SOUTH		78.1	35
	ENTER BUSINESS AREA	80.4	30
	EXIT BUSINESS AREA	81.1	35
WARREN ROAD WEST		84.1	35
	ANN ARBOR TRAIL	87.4	40
NEWBURGH ROAD SOUTH		95.2	40
FORD ROAD WEST		95.9	45
I-275 NORTH		97.7	55

MILEAGE ACCUMULATION ROUTE

LOCATION OF TURN	LOCATION OF SPEED CHANGE	ODOMETER	SPEED LIMIT (MPH)
8 MILE ROAD EAST		105.7	50
	FARMINGTON ROAD	107.7	40
FARMINGTON ROAD NORTH		111.6	40
9 MILE ROAD WEST		112.6	40
	HAGGERTY	115.5	35
MEADOWBROOK ROAD NORTH		116.6	30
	10 MILE ROAD	117.6	40
GRAND RIVER WEST		118.4	50
	ENTERING BUSINESS AREA	119.1	40
NOVI ROAD NORTH		119.3	30
	NORTH OF 96	119.7	40
	12 MILE ROAD	120.1	30
EAST WALLED LAKE DRIVE NORTH		121.4	30
	14 MILE ROAD	122.6	25
PONTIAC TRAIL NORTH/EAST		123.3	35
	SOUTH COMMON ROAD	124.1	40
	WELCH ROAD	125.1	45
	ENTERING RESIDENTIAL AREA	128.7	35
ORCHARD LAKE ROAD NORTH		130.6	35
MIDDLEBELT ROAD SOUTH		133.7	40
	LONG LAKE ROAD	135.5	45
LONE PINE ROAD EAST		136.5	35
INKSTER ROAD SOUTH		137.5	35
WELLINGTON NORTHEAST		141.3	25

MILEAGE ACCUMULATION ROUTE

LOCATION OF TURN	LOCATION OF SPEED CHANGE	ODOMETER	SPEED LIMIT (MPH)
FRANKLIN ROAD NORTH		142.5	35
	EXIT BUSINESS AREA	143.2	40
QUARTON ROAD EAST		144.7	40
TELEGRAPH ROAD SOUTH		145.6	50
QUARTON ROAD EAST		145.9	35
CRANBROOK ROAD SOUTH		148.3	25
	MAPLE	149.3	30
	14 MILE ROAD	150.4	25
	CRANBROOK BECOMES EVERGREEN	151.4	35
	12 MILE ROAD	152.4	40
CIVIC CENTER DRIVE WEST		153.9	35
11 MILE ROAD WEST		156.8	45
INKSTER ROAD SOUTH		158.2	35
8 MILE ROAD WEST		161.1	40
MERRIMAN ROAD SOUTH		163.1	40
I-96 EXPRESSWAY WEST		167.1	55
LEVAN ROAD SOUTH		168.6	40
COMMERCE STREET WEST		169.1	25
ECS LABORATORIES (FINISH)		169.4	


I-96
I-275
PLYMOUTH
GRAND RIVER
WARREN
FORD
MICHIGAN
6 MILE
7 MILE
8 MILE
9 MILE
NEWBURGH
INKSTER
MIDDLEBELT
TELEGRAPH
EVERGREEN
LAUREL PARK

Attachment B

ATL/Bendix

EPA MILEAGE ACCUMULATION
AS ADAPTED TO BAPG THREE MILE TRACK

The schedule consists basically of 11 laps of a 3.0 mile course. The basic vehicle speed for each lap is listed below:

Lap	Speed MPH
1	40
2	30
3	40
4	40
5	35
6	30
7	35
8	45
9	35
10	55
11	55

During each of the first nine (9) laps there are 3 stops with 15 second idle. Normal accelerations and decelerations are used. In addition, there are 4 light decelerations each lap from the base speed to 20 mph followed by light accelerations to the base speed.

The 10th lap is to be driven at a constant speed of 55 mph after a normal acceleration from the stop following lap 9 and proceeding to a normal deceleration to a stop before lap 11.

The 11th lap is begun with a wide open throttle acceleration to 55 mph, a fast deceleration to a stop, and two (2) subsequent wide open throttle accelerations and fast decelerations at evenly spaced intervals in the 3.0 mile lap.

Attachment C-1

SCHEDULE A

DURABILITY FLEET TEST OUTLINE

EMISSION TESTING

ODOMETER	DESCRIPTION
0	A1. Check car for all emission related equipment hook-ups. Record any changes from car in the "as rec'd condition"
	A2. Record catalyst converter numbers.
	A3. Drain fuel and refill with Howell EEE emission fuel.
	A4. Run CVS-FTP emission prep cycle.
	A5. (Day 1) Run FTP emission cycle test. (Maxi and mini CVS data).
	A6. (Day 2) Run FTP emission cycle test. (Maxi and mini CVS data).
	A7. (Day 3) Obtain 3rd FTP if HC, CO, NOX variability is unacceptable.
	A8. Begin mileage accumulation on EPA type durability cycle.
1000	B1. Perform steps A3 through A7 - hold cars for grouping.
	B2. Group cars into sets of three for each model and fill fuel tanks with proper fuel (one car on Howell EEE fuel and each remaining car on Howell EEE fuel plus a specific MMT™ antiknock compound concentration.
At each 5000 mile segment through 5000 miles.	C1. Perform steps A3 through A8.
At mileage specified by manufacturer	C2. Oil and filter change.
At major maint. point	D1. Oil and Filter change D2. Perform steps A3 through A7. D3. Perform maintenance as required by mfr. D4. Perform steps A3 through A8.

Attachment C-1

SCHEDULE A

DURABILITY FLEET TEST OUTLINE

EMISSION TESTING

ODOMETER	DESCRIPTION
1000	A1. Group cars into sets of three for each model and identify proper fuel for each car (one car on Howell EEE fuel and each remaining car on Howell EEE fuel plus a specific MMT™ antiknock compound concentration.
	A2. Drain fuel and refill with ~~proper~~ Howell EEE emission fuel.
	A3. Run CVS-FTP emission prep cycle.
	A4. (Day 1) Run FTP emission cycle test. (Maxi and mini CVS data).
	A5. (Day 2) Run FTP emission cycle test. (Maxi and mini CVS data).
	A6. (Day 3) Obtain 3rd FTP if HC, CO, NOX variability is unacceptable..
	A7. Begin mileage accumulation on EPA type durability cycle.
At each 5000 mile segment through 50000 miles.	B1. Perform steps A2 through A7.
At mileage specified by manufacturer	B2. Oil and filter change.
At major maint. point	C1. Oil and Filter change C2. Perform steps A2 through A6. C3. Perform maintenance as required by mfr. C4. Perform steps A2 through A7.

DLL - 7/19/88

1000 mile Summary
Dodge Dynasty - 3.0L Auto.

	HC	CO	NOx	mpg	Fuel *
D1 - :	0.272	1.579	0.608	20.44	
	0.300	1.816	0.571	20.53	Clear
	0.286	1.698	0.590	20.48	
D-2	0.278	1.624	0.496	20.85	
	0.290	1.743	0.517	20.78	Clear
	0.284	1.684	0.506	20.82	
D-3	0.286	1.657	0.656	20.75	
	0.258	1.578	0.696	20.90	Clear
	0.272	1.618	0.676	20.82	
D-4	0.293	2.048	0.759	20.70	
	0.287	1.582	0.656	20.94	MMT
	0.290	1.815	0.708	20.82	
D-5	0.270	1.565	0.616	21.99 (?)	
	0.278	1.667	0.600	20.49	MMT
	0.274	1.582	0.608	21.24	
D-6	0.264	1.938	0.544	20.44	
	0.279	1.522	0.583	20.49	MMT
	0.272	1.730	0.564	20.46	
N=	12	12	12	12	
M =	0.280	1.693	0.608	20.78	
σ =	0.012	0.157	0.072	0.406	

* per agreement with EPA on 7/21/88 JMM, Dwight

1000 MILE
Buick 2.5L Aro

B-1		0.095	0.898	0.132	24.76
		0.093	0.944	0.138	24.70
		0.094	0.921	0.135	24.73
B-2		0.097	0.157	0.136	23.95
		0.092	0.662	0.160	23.72
		0.094	0.660	0.148	23.84
B-3		0.092	0.761	0.140	24.44
		0.108	0.817	0.168	24.25
		0.100	0.789	0.154	24.34
B-4		0.130	0.695	0.144	24.52
		0.099	0.692	0.142	24.77
		0.114	0.694	0.143	24.64
B-5		0.116	0.805	0.183	23.85
		0.086	0.819	0.198	24.21
		0.101	0.812	0.190	24.03
B-6	(?)	0.191	0.746	0.173	24.28
		0.090	0.788	0.178	24.70
		0.140	0.767	0.176	24.49
N.		12			
$\bar{x}$		0.107	0.774	0.158	24.34
σ		0.028	0.086	0.020	0.350

HOWELL HYDROCARBONS INC.
EEE Unleaded Gasoline

Attachment D

Batch No._____ Tank_____ Date Approved:_____

ITEM	ASTM	HHI SPECS MIN.	HHI SPECS MAX.	FED SPECS MIN.	FED SPECS MAX.	ANALYTICAL RESULTS
Specific Gravity, 60/60	D1298	0.734	0.744			
Gravity, °API	D1298	58.7	61.2			
Research Octane Number	D2699	96.0		93.0		
Motor Octane Number	D2700	Report				
Sensitivity		7.5		7.5		
Lead, gm/gal	D3237	0.000	0.050	0.00	0.05	
Distillation Range, °F	D86					
IBP		75	95	75	95	
10%		120	135	120	135	
50%		200	230	200	230	
90%		300	325	300	325	
End Point			415		415	
Sulfur, wt%	D3120		0.100		0.10	
Phosphorous, gm/gal	D3120		0.100		0.10	
Reid Vapor Pressure, psi	D323	8.8	9.2	8.7	9.2	
Hydrocarbon Composition, vol%	D1319					
Olefins		10.0			10	
Aromatics		35.0			35	
Saturates		Report				
Existent Gum, mg/100ml	D381		5.0		(a)	
Copper Strip Corrosion	D130		1		(a)	
Oxidation Stability	D525	240			(a)	
Particulate Matter, mg/l	D2276		1.0		(a)	
*Fuel Economy Numerator		2401	2441		(a)	
*C Factor		Report			(a)	
Alcohol, vol%			0		(a)	
Carbon Weight Fraction	E191	Report			(a)	
Hydrogen Weight Fraction	E191	Report			(a)	
Net Heating Value, btu/lb	D240	Report			(a)	
Carbon Weight Fraction	D3343	Report			(a)	
Net Heating Value, btu/lb	D3338	Report			(a)	
Color						

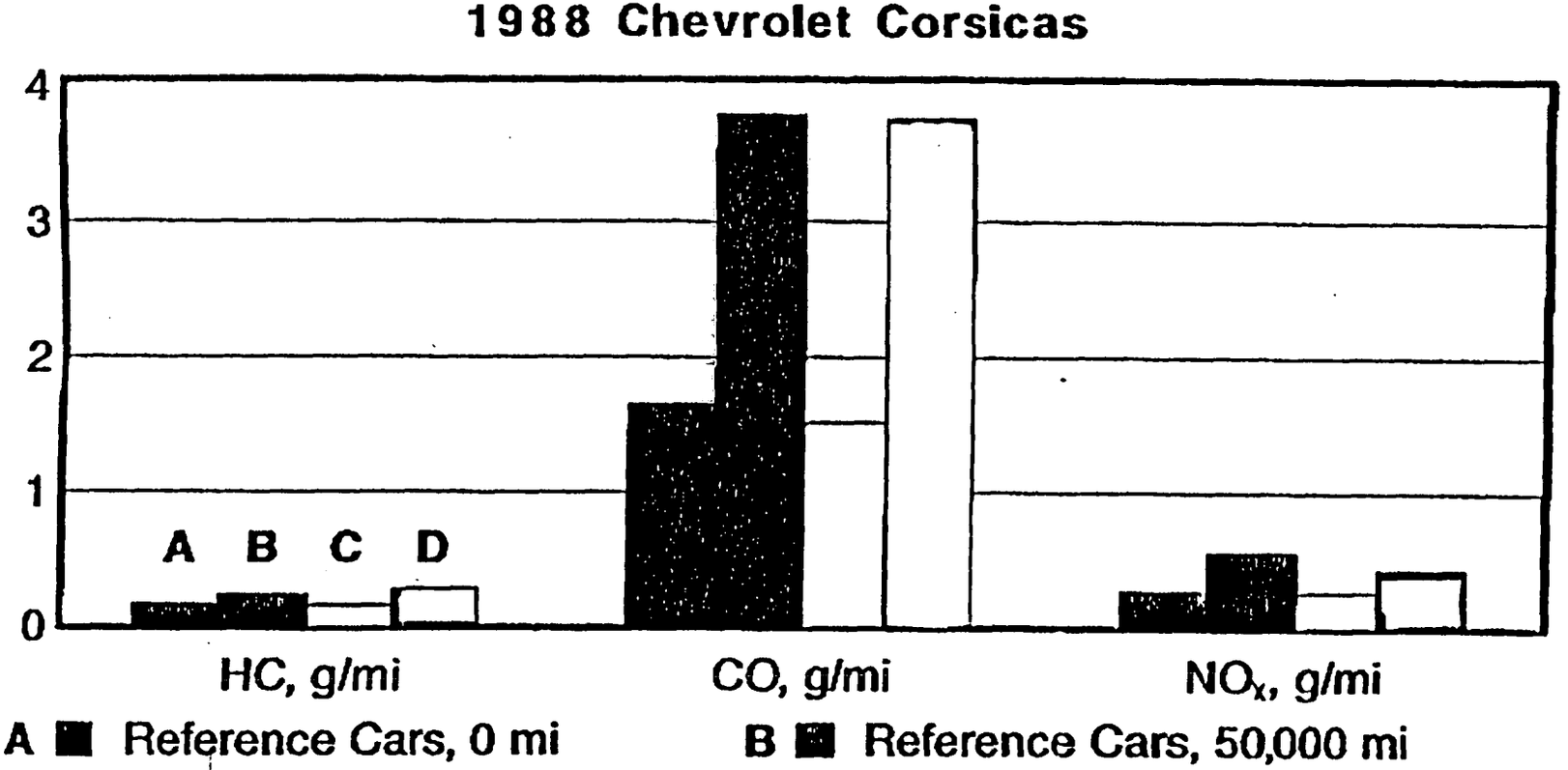
Approved By:_____
Joel Moreno

*Fuel Economy Numerator and C Factor calculated using E191 and D240 values.

(Draft Slide)

AUTOMOTIVE EMISSIONS

1988 Chevrolet Corsicas



A ■ Reference Cars, 0 mi

B ■ Reference Cars, 50,000 mi

C □ MMT™ Cars*, 0 mi

D ■ MMT™ Cars*, 50,000 mi

*0.03125 g Mn / gallon

Ethyl

Ethyl Petroleum Additives Division
20 South 4th Street
St. Louis, MO 63102-1886
(314) 421-3930

July 22, 1988

Mr. Richard G. Kozlowski
United States Environmental Protection Agency
401 M. Street, S.W.
Washington, DC 20460

Dear Mr. Kozlowski:

During our meeting on July 21 with members of your staff we modified the "random vehicle pairing" process referred to in my July 19, 1988 letter. All parties agreed that, while random selection appeared appropriate, a more defined system would aid the pairing process in some instances. Specifically, we agreed to the following "pairing" process for each engine/model group.

1. Rank the vehicles in order using tailpipe hydrocarbon emissions as the primary separation factor;
2. Assign the highest emission vehicle to the appropriate fuel using a random even/odd coin flip. As a note, "heads" represents the clear/reference fuel;
3. Assign the next highest emission vehicle to the other fuel;
4. Select the next two emission ranked vehicles and assign the higher emission vehicle to the lower emission vehicle of pair one. The lower emission vehicle is assigned to the higher emission vehicle;
5. Repeat Step #4 using the second vehicle pair as the determinants;
6. In the case of equal hydrocarbon emission results, the vehicles are separated by Step #2.

We trust the above information and the information contained in my July 19 letter are acceptable, however, if their are any questions or comments please feel free to contact me or J.G. Smith.

Sincerely,

J.M. McChesney
Senior Product Manger

/dp

CC: Mr. Barry Nussbaum-EPA

ETHYL PETROLEUM ADDITIVES DIVISION

INTER-OFFICE

To Distribution Address

From J.M. McChesney Address

Subject Feb. 4, 1988 Meeting with General Motors Date 2/11/88

While based on previous meeting reports on MMT, I expected an antagonistic atmosphere, the meeting was polite and cordial. There remains little doubt that GM will be negative toward a MMT waiver, unless we provide data demonstrating no effect on emissions. GM is worried about field performance and recalls irrespective of MMT and the possibility of increasing the problem is paramount in their minds. Reportedly, GM tests 500-1000 cars each year for in-use emission surveillance.

Following a discussion of the fleet selection process, GM agreed with our proposal to test a:

* 2.8 - L V-6
* 2.5 - L L-4 (pelleted convertor)
* 3.8 - L V-6 (not the 3800 engine)
* 2.0 - L L-4 (existing Corsicas)

The interesting comment on the total fleet size which mirrored EPA comments in December "pretty good size fleet". Based on the Corsica data and GM's comments we quickly realized that a duplicate clear fleet will be required.

Since this undertaking is being geared to provide answers to as many questions as possible without jeopardizing the emissions testing, we invited comments from GM. Their biggest concerns with MMT are as follows:

a. No statistical effect on emissions: GM referred to their 36 car methanol fleet (18 on MeOH, 18 on clear) as an example. They feel any difference in emissions must be 20% or greater to be statistically significant. This statement works both ways, ie according to this we could be 15% above and not have a problem. Our goal is to be equal or lower.

b. No catalyst plugging: The old concerns and misconceptions are still with us. We reviewed the correct feature that at 0.0625 g Mn/gal or lower there were no problems, but as originally planned we will provide catalyst data. Since plugging is a function of dose and catalyst temperature we asked about current temperatures, but the answer was unknown. As a

note, the same issue came up in Canada and we learned current temperatures were less than 1550°F.

In a separate note, catalysts are now 400 cells/inch vs 280 in 1978.

c. No oxygen sensor degradation: The concern is negative biasing of sensors. We mentioned the no-effect results of the recent O2 sensor tests in the Corsicas.

d. No spark plug fouling: Specifically cold start performance and bridging. Mr. Colucci was very interested in the Canadian (Shell) problem which MMT alleviated and in our old "soot-fouling" work. (Information will be sent to GM).

e. 100,000 mile performance: The Clean Air Act amendments and the impact on light-duty truck emissions from MMT are responsible for this one. As you know, the Corsicas are slated for 50,000 + testing.

f. ONRI: This is interesting since when I mentioned it, GM's first statement was "we are happy with regular and don't need premium gasoline," but they would be interested in the data.

Regarding GM's future engine plans they will continue the attempt to consolidate engine selections, fine tune the 3800 engine, but don't expect large conversion to the Quad-4 engine.

Present for GM: Joe Colucci-Dept. Head-Fuels and Lubricants

Jack Benson-GMR Fuels & Lubricants

Bob Everett-Asst. Director-Automotive Emission Control-Environmental Activities

Harold Haskew-Mgr. Emission Performance GM Proving Ground

Al Grandle-GM Canada

Greg Sims-AC Division

Present for EPAI: J.M. McChesney, J.P. Sunne, D.L. Lenane

J.M. McChesney

/dp

ETHYL PETROLEUM ADDITIVES DIVISION

INTER-OFFICE

To Distribution — Address

From J.M. McChesney — Address

Subject February 4, 1988 Meeting with Chrysler — Date 2/11/88

While we didn't expect support from Chrysler, they were more vocally negative than GM. Gordon Allardyce let us know that in no uncertain terms he (Chrysler) will be against an MMT waiver. This statement was based on previous waiver applications, the CRC test data and old Chrysler data. Concerns for in-use surveillance and recalls were often mentioned. Having spoken. Mr. Allardyce left the meeting early.

Chrysler's vehicle sales clearly indicate that the big volume engine is the 2.2 l 4 cylinder engine, but they surprised us by suggesting the 3.0 l V-6 engine. This engine is built by Mitsubishi and is reported to be representative of Chrysler's future engines. This engine is in 80% of the Caravan mini-vans. They did not request more than one engine from their fleet.

In addition to emissions data (tail-pipe and engine-out) Chrysler would like to see:

a. 100,000 mile performance: This relates to GM's interest, but the selection of the 3.0 l V-6 engine in a passenger car should answer this question.

b. Severe duty testing: Specifically, Allardyce feels the EPA cycle is too mild and that we should test for the "way 10% of their owners drive". This is mutually exclusive of an EPA waiver test, therefore, a non-issue.

c. Engine wear data: This stemmed from an unsubstantiated claim that Canadian cars had higher wear rates than US and the fuel was the variable. Another Chrysler representative claimed their were no problems in Canada.

d. System durability: Catalyst plugging and oxygen sensor fouling were mentioned.

Present for Chrysler:

George Shishkovsky-Mgr. Fuels & Lubricants
John Muir-Fuels & Lubricants
Sid Feldsteen-Fuels & Lubricants
Michael Brady-Catalyst Development
Phil Wilson-Catalyst Development
Howard Garon-Engine Development
Dennis Austia-Fuel Supply & Exhaust Systems
Bob Lee-Advanced Engine Engineering
Tom Asmus-Advanced Engine Engineering
Connie Pell-Certification & Regulatory Programs
Gordon Allardyce-Certification & Regulatory Programs

Present for EPAI: J.M. McChesney, J.P. Sunne, D.L. Lenane

J.M. McChesney

/dp

ETHYL PETROLEUM ADDITIVES DIVISION

INTER-OFFICE

To MMT Waiver File Address

From J.M. McChesney Address

Subject February 5, 1988 with Ford Motor Co. Date 2/11/88

True to form, Ford is negative toward an MMT waiver and they "won't believe anything without paired vehicle testing". Ford remains interested in "determining the effect" of MMT on engine-out emissions and suggested that we install dummy catalysts for engine-out measurements instead of the more practical mini-CVS pre-catalyst sampler. Ford is worried about field performance, recalls, and certification if MMT is allowed. Ford did not claim to see any problems in Canada due to the use of MMT. Ford does want to see the Australian data on the Holden Commodores when the test concludes.

Fortunately, (or perhaps unfortunately) Ford reviewed the vehicle fleet selection and agreed with our suggestion. I use the word unfortunately since the 5.0 l V-8 engine in the rental car program produced failing HC data in both U.S. and Canadian cars. The 5.0 l engine is a known high emission engine which, fortunately, exhibits a very minimal effect to MMT. The Ford engines selected are the:

* 1.9 - L 4-cylinder
* 3.0 - L V-6
* 5.0 - L V-8 (close coupled dual catalyst system without air injection; ie 4 convertors)

It is interesting to note that Ford did not expect to have three engines/models in the fleet. All catalyst systems are monoliths, but operating temperatures were unknown.

Items of interest and/or concern in addition to no increase in exhaust emissions due to MMT are:

a. Catalyst plugging: The background on this actually came from H. Gandhi's statement that 25% manganese is retained on the catalyst, therefore, it will be a problem. As a note, Gandhi co-authored SAE paper 821193 titled "Effects of Fuel Additive MMT on Contaminant Retention and Catalyst Performance".

b. 100,000 mile performance: Ford's logic paralleled GM.

c. End of test immediate effect: Ford would like to see the effect of switching from MMT fuel to clear fuel at 50,000 miles. We will have similar data from the Corsica program cars which operated for 15,000 miles on MMT (.06g) and OGA-480. These cars are now operating on clear fuel for 5,000 miles.

d. Oxygen sensor and spark plug fouling.

As a market related comment, Ford does not expect multi-valve engines to be a factor in their long range plan.

Present for Ford: Dick Baker - Mgr. Fuels & Lubricants
Mordecai Shelef - Science Research Staff
Haren Gandhi - Science Research Staff
Mike Schwartz - Auto Emissions Staff
DeWain Belote - Auto Emissions Staff
Nabil Raid - Electrical & Electronics Staff

Present for EPAI: J.M. McChesney, J.P. Sunne, D.L. Lenane

J.M. McChesney

/dp

ETHYL CORPORATION

Inter-Office

TO: Distribution **ADDRESS:**

FROM: G. L. Ter Haar **ADDRESS:** BRT-6

SUBJECT: Visits With the Automotive Industry Regarding HITEC 3000 **DATE:** April 27, 1990

John Sunne and I visited with representatives of General Motors, Chrysler and Ford on April 25 and 26. We showed them the data from our completed 75,000 mile fleet test.

John Sunne was able to arrange a meeting with Joe Collucci at the Automotive Petroleum Industry Forum on April 25. In the morning, Mr. Collucci had presented a paper titled, "What Can the Oil Industry Do in the 1990s--An Auto Man's Perspective". Regarding manganese, he said, "Gasoline should not contain metallic additives. Additives containing lead and manganese are known to increase combustion chamber deposits and engine hydrocarbon emissions. Lead is essentially gone, and we don't want manganese to return. With the standard for exhaust HC emissions being racheted down to 0.252g/mile, with 0.125, 0.075 and 0.04g/mile being discussed in California, there is no margin for error, and even slight increases due to metallics cannot be tolerated. Also, with increasing concern over air toxics, it is unlikely that metallic additives will be successful." Mr. Collucci went on to chide the oil industry for pushing octane on the customer, which he claims they don't need. His paper basically states there is more than adequate octane if the customer would only use the octane necessary to keep his car from knocking.

With that prejudice from Mr. Collucci facing us, we sat down and talked with him on Wednesday afternoon. Initially, he was not really interested in even looking at the data. He stated that it was a known fact for 20 years hydrocarbons had been increased by the use of manganese and our data similarly showed such an increase. However, we talked to him for about a half an hour and gradually helped him to understand that there was a significant benefit from the use of HITEC 3000 and General Motors cars could meet hydrocarbon standards to 75,000 miles but could not meet them for nitrogen oxides unless they used HITEC 3000. He continued to stress cars could be recalled because they exceeded the hydrocarbon standard and it could be due to manganese. I, in turn, stressed they were more likely to have the cars recalled because they could not meet the nitrogen oxide standard. He finally agreed to take the data, to discuss it

with his staff and to look at the trade-offs between nitrogen oxide reductions, CO reductions and a small hydrocarbon increase. We could take some comfort that the report we gave him was open to the page on nitrogen oxide reductions when we finished the discussion.

At the evening banquet, Dave Wilson and I had an opportunity to meet with Jack Benson, second in charge in Collucci's group. We had hoped we could further persuade him on the merits of HITEC 3000. However, Mr. Benson has a new assignment dealing with the Oil-Auto Company Cooperative Program on Alternate Fuels. He has been relocated to the General Motors proving grounds where he is responsible for testing of automobiles on various fuel combinations and analytical work. Thus, there is little likelihood he is going look at the MMT data at all. Hopefully, others of Collucci's staff will examine it.

On Thursday morning we talked with Chrysler. Gil Clark, a long time Ethyl employee, who has now worked for Chrysler for about six or seven years, Michael Brady, Research Scientist in Catalyst Development, and Frank Krich, Planning Specialist in Regulatory Affairs, joined John and me for the discussion. They were relatively receptive to the fact that their Dodge Dynasty did not perform well in our tests. They did not dispute the data and only wished they had given us another model which they believe would have done better. We pointed out to them the benefit in the other cars of HITEC 3000 on nitrogen oxides. Unfortunately, in the Dodge Dynasty there was no positive or negative effect from HITEC 3000 on nitrogen oxide emissions. While we got a very warm reception at Chrysler, we must point out that Allerdyce did not join us. In a previous meeting, Allerdyce came in for five minutes, told the Ethyl people he was unalterably opposed to manganese in gasoline and left the meeting. He chose not to meet with us on Thursday.

We also met with Ford on Thursday morning. Haren Gandhi, Manager and Senior Staff Scientist in the Chemical Engineering Department, and Roberta Nichols, Manager, Alternate Fuels Department, met with us. Mr. Gandhi basically did not believe the NOX data. He could not understand how manganese could be catalytic for nitrogen oxide conversion and rejected the concept. We pointed out we were not sure about theory but it was very clear for 75,000 miles that 48 cars showed significantly lower nitrogen oxide emissions compared to clear fuel cars. Miss Nichols was somewhat more receptive. As she is working on alternate fuels where nitrogen oxides are a problem, she was interested in the possibility that MMT could be helpful to controlling nitrogen oxide emissions.

We asked all three groups whether they favored taking any of the cars to 100,000 miles. Mr. Collucci's view was neutral. The Ford people slightly favored going on to 100,000 miles, but had no strong feelings on the matter. Chrysler similarly had little feeling one way or another except they favored taking

their car despite its high emissions to 100,000 miles. Overall, there was little sentiment to continue on to 100,000 miles. None of them were particularly persuaded that EPA would find the data to 100,000 miles useful.

We may have made some small progress with the three auto companies, however, they are by no means convinced that they should support a manganese waiver. They have had such a long history of opposition to the use of manganese in fuel that certainly at the technical level we will not persuade them of our position. Nevertheless, all groups agreed to look over the data and meet with us again in four to eight weeks. At that time, their technical people and our technical people, including particularly Dennis Lenane, will meet with them to answer any questions they have, and hopefully, we can take one more shot at persuading them of the benefits of this product. Failing that, it may be appropriate to write some letters to higher management in the auto companies pointing out the benefits that they are missing by not supporting the HITEC 3000 waiver.

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TECHNICAL RESPONSE TO COMMENTS SUBMITTED BY FORD AND CHRYSLER

I. Introduction

In their comments on Ethyl's waiver request, several representatives of the automobile and catalyst industries expressed concern on the approval of HiTEC 3000 in unleaded gasoline. Specifically, Ford and Chrysler cited several old publications dealing with catalyst plugging and vehicular emissions. Both companies presented limited information on converters that had been removed from Canadian vehicles. This technical discussion responds to their comments.

Prior to this waiver submission, during the period from 1975 through 1979, Ethyl Corporation ("Ethyl") and the auto industry conducted substantial research on the effect of HiTEC 3000 (MMT) on catalyst operations. This research culminated in an extensive study conducted by the Coordinating Research Council (CRC) in 1978.[1] As a part of this test program, pressure drop across the catalyst in 63 test vehicles was measured during a wide-open throttle acceleration from 0 mph to 50 mph. There was no indication of plugging in any of the car models after 50,000 miles of vehicle operation with fuels containing 0, 1/32 and 1/16 gm Mn/gallon.[2]

Most of the other research conducted from 1975 to 1979 was done at manganese concentrations of 0.1250 gm Mn/gallon (1/8 gm Mn/gallon), a level four times higher than that requested in this proceeding. While these studies showed that manganese oxides may contribute to catalyst plugging under prolonged, severe engine operating conditions with high concentrations of manganese in the fuel,[3][4][5] this early research recognized that severe high temperature engine operations were abnormal and would only occur "a small portion of the time they were operating."[6]

At the time of these earlier studies, automotive companies were striving to meet new Federal and State of California vehicle emission

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[1]"CRC MMT Field Test Program," CRC Report No. 503, June 1979.

[2]"CRC MMT Field Test Program," CRC Report No. 503, June 1979.

[3]"Update on MMT as Related to Canadian Gasolines".

[4]SAE 770655, "Manganese Fuel Additive (MMT) Can Cause Vehicle Problems"

[5]SAE 780004, "How Manganese Causes Plugging of Monolithic Converters".

[6]SAE 780004, page 6.

regulations. Consequently, several of the test models used were first generation California emissions systems. As a result, data from the 1975-1979 era cannot be relied upon to predict catalyst performance in Ethyl's 1988 model test fleet.

In 1986, to verify that catalyst plugging was not a problem in Canadian cars, a working group of the Canadian General Standards Board (CGSB) reported on the effect of MMT on vehicle tailpipe emissions and emission control systems. Members of the working group included representatives from the Motor Vehicle Manufacturer's Association and Automobile Importers of Canada in addition to the petroleum industry and Canadian governmental agencies. Fifteen in-use Canadian cars were tested in 1984 by Environment Canada.[7] The cars were equipped with U.S.-type three-way catalysts. They had been fueled with typical Canadian gasolines containing up to 18 mg Mn/L (0.068 gm Mn/U.S. gallon). All of the cars met existing Canadian standards for hydrocarbons, and would not have exceeded the proposed 0.41 gm/mile HC standard based on extrapolation. The working group concluded:

> "Current systems do not indicate that durability is lower in Canada, where MMT is used, than in the United States where MMT is disallowed in unleaded gasoline. Members of MVMA and AIC indicate that manufacturers' Canadian warranty claims on emission components are comparable to the U.S."[8]

The statement that warranty claims on emission systems are comparable in Canada and the U.S. cannot be over-emphasized. It shows convincingly that HiTEC 3000 does not cause catalyst deterioration, the more recent claims of several automobile companies to the contrary notwithstanding.

II. Ford Comments on Catalyst Plugging

In their comments, Ford submitted data on 10 converters (11 catalysts) that were removed from vehicles operated by employees of Ford of Canada.[9] These vehicles were reported to have had proper maintenance and had experienced no driveability problems. Ethyl has analyzed the data and offers the following comments.

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[7]"An Assessment Of The Effect Of MMT On Light-Duty Vehicle Exhaust Emissions In The Canadian Environment", CGSB Gasoline and Alternative Automotive Fuels Committee, April 4, 1986.

[8]"An Assessment Of The Effect Of MMT On Light-Duty Vehicle Exhaust Emissions In The Canadian Environment", CGSB Gasoline And Alternative Automotive Fuels Committee, April 4, 1986.

[9]Ford submission, Attachment 1.

The 11 catalysts, as well as the two sets of catalysts reported from other studies, were evaluated under Ford's proprietary post-mortem laboratory test procedure. Ford apparently is the only U.S. automotive manufacturer that uses this laboratory procedure for catalyst conversion efficiency. Ford did not include any data that show a correlation between this laboratory procedure and actual vehicle performance nor did they report actual emissions from the automobiles before removing the catalysts. Ethyl believes that actual emissions data are more credible than simulated laboratory conditions.

Ford's post mortem laboratory analysis emphasizes redox ratios greatly outside of normal operating conditions. As discussed in Automotive Electric/Electronic Systems by Bosch, the air-fuel mixture supplied to the engine and thereby the exhaust, should be at the stoichiometric ratio.[10] Under stoichiometric conditions, redox ratio = 1, HC conversion efficiency for the catalysts exposed to HiTEC 3000 was similar to the single "non-MMT" catalyst in 9 of the 11 samples reported. No other information about the characteristics or history of the clear-fuel catalyst was provided by Ford.

However, this type of comparison is of questionable validity. There are significant differences in catalyst efficiencies between individual cars, and these differences can be influenced by in-use history. In Ethyl's controlled test fleet, HC conversion efficiencies at 50,000 miles on car models not operated on HiTEC 3000 ranged from a low of 77.6 percent to a high of 90.4 percent. A biased conclusion can be drawn depending upon the data which is selected. Thus, Ford's single catalyst comparison does not provide a basis for any valid conclusion.

In addition to the 11 catalysts noted above, Ford provided data on an Ontario Provincial police car -- 5.8L 1978 LTD, with 58,120 miles.[11] Although details were not supplied on this vehicle, it can be assumed that this engine and emission control system were part of Ford's "Interceptor" series of police vehicles. Patrol cars are subjected to long periods of idling or low speed operation, interspersed with periods of high speed acceleration. Under these conditions, records show that catalysts can fail, whether clear fuels are used, as in the U.S.,[12] or HiTEC 3000 is present as in Canada.

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[10]Automotive Electric/Electronic Systems, Robert Bosch.

[11]Ford submission, July 23, 1990, p. 2.

[12]See Attachment 1.

In a 1989 SAE paper Ford reported on 9 converters, (15 catalysts), that had been removed from Canadian vehicles at dealerships for warranty service.[13] Additional information on 13 converters (26 catalysts) was included in Ford's submission to EPA on 7/23/90. These converters "were removed from vehicles that had been returned to Canadian dealerships for poor performance and driveability problems."[14]

For the first set of converters, "it was assumed by the authors that the vehicles used for this study were properly adjusted and fueled with gasoline that met the Canadian standard of 1/16 gm/gal of MMT."[15] Ethyl challenged this assumption in their rebuttal at the SAE meeting on 3/1/89.[16] Proper maintenance and fueling can not be taken for granted. If all vehicle owners were diligent in this regard it would be unnecessary to encourage Inspection and Maintenance controls in noncompliance areas.

Ford's analysis on the second set of 13 converters confirms Ethyl's comments that poor maintenance and misfueling are the primary factors in catalyst problems. In their submission, Ford acknowledges that over 50 percent of the catalysts had been damaged by factors unrelated to the use of HiTEC 3000. Specifically, seven were damaged because of misfueling and/or poor maintenance. Included in the damaged converters were two that had high lead concentrations, four that were exposed to temperatures above 1000° C and one had both high lead concentration and exposure to high temperature. Based on this information from the second set of catalysts, it is reasonable to assume that Ethyl's challenge to SAE 890582 concerning proper maintenance and fueling is accurate.

Another item which should be addressed relative to Ford is the difference between pre-1988 Canadian standards and current U.S. standards (Table I). Of the 52 Canadian catalysts reported by Ford, only 11 were from 1988 or newer model year vehicles. Conversion efficiency information from the remaining catalysts cannot be compared to a U.S. catalyst. Those Canadian catalysts were designed for different standards.

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[13]SAE 890582, "Characterization of Automotive Catalysts Exposed to the Fuel Additive MMT".

[14]Ford submission, Attachment 2, page 3.

[15]SAE 890582, page 1.

[16]Ethyl submission, 7/23/90, Attachment 11, page 4.

TABLE I

Canadian Emission Standards

gm/mi

	HC	CO	NOx
Pre-1988	3.5	25.8	3.2
1988	0.41	3.5	1.0

Ethyl's analysis of data on the combined sets of converters showed no correlation between manganese on the catalyst and conversion efficiency for HC, CO and NOx.

The current catalyst data reported by Ford are also inconsistent with results Ford reported earlier. In 1982 Ford conducted a study and published a paper that concluded

> "...use of 0.125 gm Mn/gallon as MMT significantly reduces phosphorus and zinc retention levels at the catalyst inlets by approximately 20-fold and 5-fold, respectively...while the TWCs (three-way catalysts) maintained significantly higher 3-way conversions than in the absence of MMT."[17]

HiTEC 3000 has been shown in many field test programs to have no adverse effect on catalyst conversion efficiency. For example, in the recent fleet test, Ethyl determined that the average conversion efficiency for catalysts run on HiTEC 3000-fueled cars were similar for HC, slightly higher for CO and 2 percentage points higher for NOx when compared to clear-fuel catalysts at the 50,000 mile point. For the Ford automobiles in the test program, the conversion efficiencies for the HiTEC 3000-fueled cars were 1.5 to 3.0 percentage points higher for all three pollutants when compared to the clear-fueled automobiles.[18]

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[17]Effects of Fuel Additive MMT on Contaminant Retention and Catalyst Performance, SAE Paper 821193.

[18]Ethyl waiver, Appendix 3, Attachments 3-12,3-13,3-14.

In Appendix 3 of Ethyl's submission, data was reported on two 1989 Ford Crown Victorias equipped with 5.0L engines and dual split-bed, close-coupled catalyst systems. The cars were operated for 25,000 miles at speeds up to 65 mph and then an additional 10,000 miles at speeds up to 80 mph. The driving condition was selected to demonstrate that HiTEC 3000 does not cause or contribute to emission system failure. Results of this test show that even under prolonged high speed, high temperature driving conditions, use of the additive at the concentration requested does not adversely affect catalyst operation.

At the completion of the program the catalytic converters were removed from the respective vehicles and installed on a slave vehicle. This vehicle, a 1989 5.0L rental car, was used to generate the exhaust gases for the conversion efficiency measurements reported below in Table II. These conversion efficiency results coupled with the back pressure results reported in Appendix 3 of the waiver clearly demonstrate that the use of the Additive has no detrimental effect on catalyst performance.

TABLE II

Ethyl High Speed Test

	Conversion Efficiency, %		
Fuel	HC	CO	NOx
Clear	91.4	94.6	59.4
H-3000	92.1	94.3	58.5

In an effort to monitor the performance of Canadian vehicles operating on gasoline containing HiTEC 3000, Petro-Canada has an ongoing program. This program was reported in their submission to the waiver docket.[19] Included in their program are a variety of employee vehicles of which photographs of a catalyst from a 1986 3.0L Ford Taurus may be found in Attachment 2. This vehicle had accumulated 170,000 km (102,000 mi) of consumer service prior to the emission testing reported in Table III.

The pictures show manganese deposits on the catalyst, but as noted below, the vehicle easily met the Canadian standards applicable to 1986, and considering its mileage, would most likely have met current U.S. standards at 50,000 miles.

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[19]See Petro-Canada submission.

TABLE III

1986 Ford Taurus - Petro-Canada Study

	Emissions, gm/mile		
Mileage	HC	CO	NOx
102,000	0.57	5.93	1.77

III. Ford Comments on Test Protocol

Ford commented that Ethyl's mileage accumulation fuel did not contain a deposit control additive package. They said that the "Lack of fuel detergents would cause an increase in the combustion chamber or intake valve system deposits and thereby result in an unrepresentative baseline as a reference point."

As shown in Appendix 1, Attachment 1-3, of Ethyl's Waiver Application, Howell EEE fuel meets rigid specifications. It contains very low concentrations of olefins, which are suspected of being a major cause of deposits on fuel injectors and other engine parts. Because of its inherent stability, an additive package is unnecessary to protect against fuel deposits.

This was demonstrated in Ethyl's fleet test program, based on average engine-out emissions for the vehicles on clear fuels. Hydrocarbons, carbon monoxide and nitrogen oxides showed only minor changes between the start-of-test at 1,000 miles and end-of-test at 75,000 miles (Table IV below).

TABLE IV

AVERAGE ENGINE-OUT EMISSIONS
Ethyl Fleet Test Data

	HC, g/Mile	CO, g/Mile	NOx, g/Mile
Mileage	Clear	Clear	Clear
1,000	2.157	10.32	2.18
75,000	2.102	10.78	2.26

The small change in emissions over the 75,000 mile program shows that Howell EEE fuel could not have caused the formation of deposits in the test vehicles. Additionally, driveability would have deteriorated substantially if vehicle fuel injectors had plugged. In Ethyl's test fleet, the driveability problem never arose because of improved injector design and the overall stability of Howell EEE.